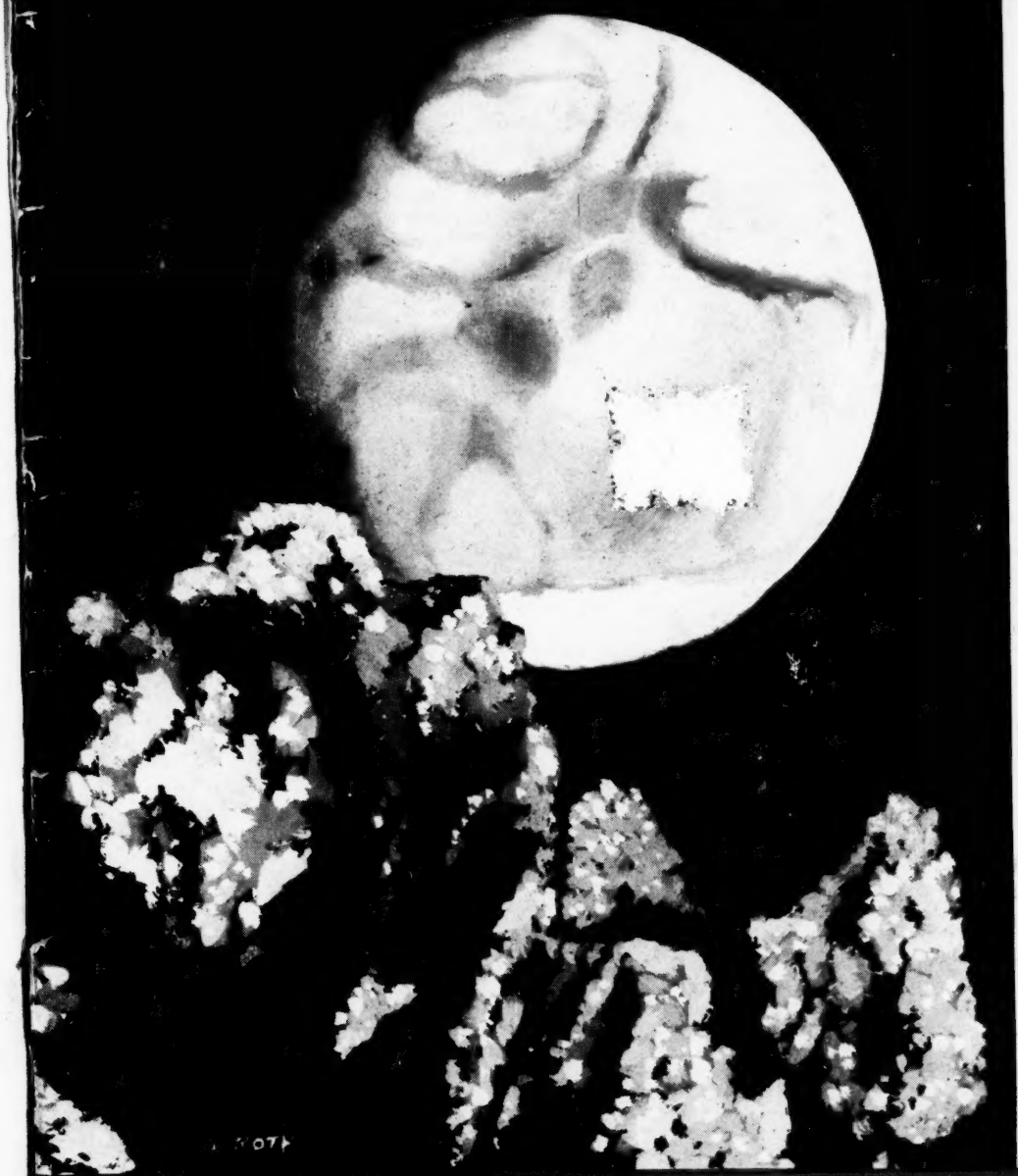
the review of POPULAR ASTRONOMY



FORMERLY . . . THE MONTHLY EVENING SKY MAP

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★ The Human Factor in Astronomical Observation

★ Through the Three-Inch

★ A Look at Refractors

★ Selecting Eyepieces and Accessories

★ New Maps and Charts of Stars and Planets

VOL. LV NO. 510

FIFTY CENTS

MARCH APRIL 1961

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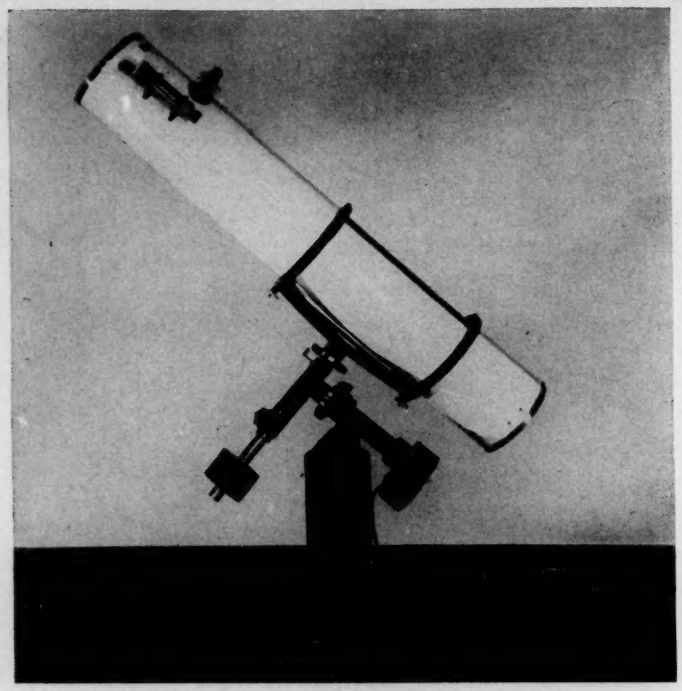

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FORMERLY THE
MONTHLY EVENING SKY MAP

the review of POPULAR ASTRONOMY

MARCH-APRIL 1961
VOL. LV WHOLE NUMBER 510

THE REVIEW OF POPULAR ASTRONOMY

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COVER PHOTO

Our unusual cover—an artist's conception of Mars as viewed from Deimos, its farther satellite — was produced by James A. Roth, [see letter, this page.]

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Articles, letters, photographs and other communications are encouraged and will be given the attention of the editors, although we cannot be responsible for their return in the case of unsolicited articles. All articles, photos, charts and other editorial matter in the magazine are protected by copyright, and permission must be obtained from the publisher for their use in other publications.

THE AMATEUR'S FORUM

The Editors
REVIEW OF POPULAR ASTRONOMY

Under separate cover I am enclosing a photograph of my oil painting of the planet Mars (as seen from Deimos, its farther moon). The painting is based on a tabletop photo of a Mars globe with minerals in the foreground to simulate the rough surface of the satellite. The painting and the Mars globe are both my creations and are based upon 1958 sketches of Mars by Dr. Gerard de Vaucouleurs. Dr. de Vaucouleurs and I have been corresponding—he sent me a print of a Mars map which he made principally from visual and photographic observations made during 1939-1941 by E. Slipher, Lyot, Camichel, Gentili and himself—and he seemed to approve of my work.

The central meridian of the planet in the painting is 310°. It shows Syrtis Major, Deltaton Sinus, Mare Serpentis, Sinus Sabaeus, Sinus Meridiani, and Hellespont and Hellas above Syrtis Major. The north polar cap is very bright in the lower part of the globe; it is mid-winter in the northern hemisphere at the time of the painting, mid-summer in the southern.

James E. Roth
7855 Euclid Ave.
Whittier, Calif.

Dear Sirs:

I am a highway engineer and am accustomed to using aerial photos and studying them stereoscopically to observe terrain in three dimensions.

This prompts me to inquire if it is possible to view the moon in three dimensions by using photographs? These photos would have to be taken simultaneously from points on the earth (or above it) as far apart as possible so as to exaggerate the 3-D effect, as do aerial photos of the earth. Please give me any information you might have regarding this matter.

Edwin O. Weaver
715 Old Orchard Rd.
Bel Air, Md.

We believe that an astronomical writer and lecturer, William Barton, published a book on navigation in the early 1940's which touched on this subject. The difficulty is that of obtaining a sufficiently long base line for the simultaneous photos. An earth-bound baseline of nearly 10,000 miles is theoretically possible, but this would place the moon too low to the horizon at both stations to allow effective exposures. Via satellites, the project would be rather sophisticated affair.

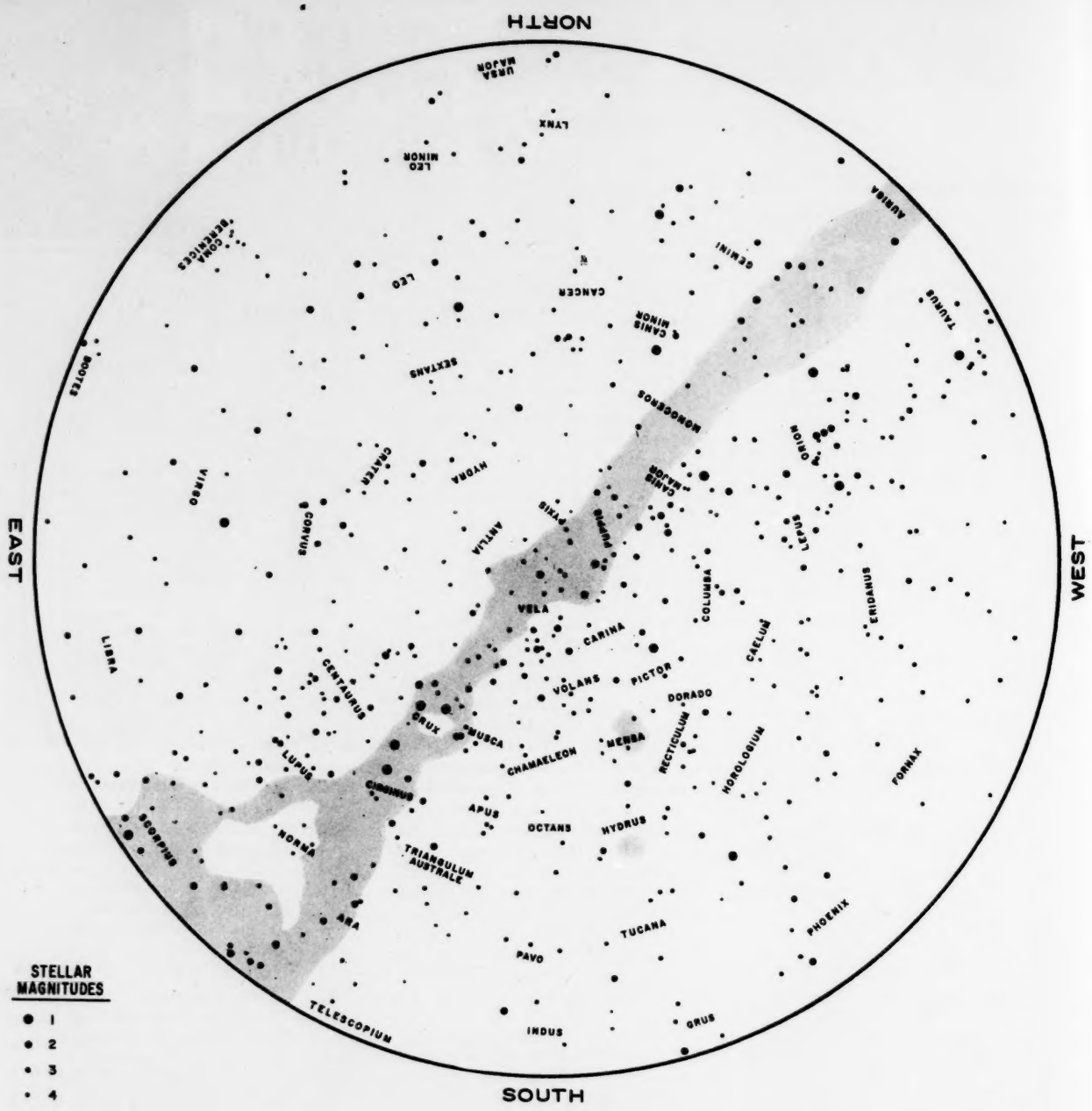
Interpretive examination of lunar topography still seems to require visual work. However, we have referred your inquiry to lunar cartographic experts at the Air Force Chart and Information Center in St. Louis. We shall advice you and our readers upon hearing from them.

Dear Sirs:

I ran across your magazine at a friend's home during Christmas and liked it very much. I especially enjoyed the article "What Was the Star of Bethlehem?" To my way of thinking, it never existed as such. I have read many explanations, but Mr. Davis' article was the best I've ever read.

Without being sacrilegious . . . I do not think that there was a "star," except as a vision or miracle seen only by the Magi. Looking for dates and possible sky oddities is a delightful pastime, but the fact remains that King Herod alerted his astronomers, who in turn had already been scanning the skies—and had seen noth-

(Continued on page 34)



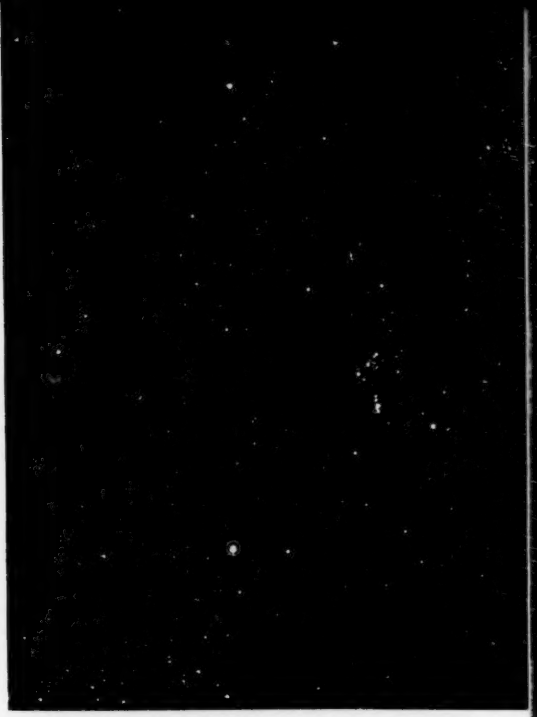
EXPLANATION OF CHART

The sky as it appears at about 9 p.m. (local time) during the latter part of March at latitude 40° south—the approximate latitude of New Zealand. All stars down to the fourth magnitude that are above the horizon at this time are shown, as well as many stars of the fifth magnitude. The hazy band of the Milky Way can be seen spanning the chart from horizon to horizon. It can be noticed that a belt of bright stars, extending from Orion in the northwest to Scorpius in the southeast, seems to skirt along the Milky Way, almost coinciding with it. This is Gould's Belt, which is described in the accompanying article. This belt encircles the entire sky, but this chart shows only its most prominent portion and is drawn to show the heavens at the time and place when this most prominent portion can be best observed. Only the names of the constellations are given; readers who wish to identify individual stars can do so by comparing this chart with a star atlas, using the constellation names shown here to guide them. The hazy patches near the constellations Mensa and Hydrus are the Large and Small Magellanic Clouds, which are neighboring galaxies of the Milky Way.
(Chart prepared by the author.)

The Great Bright Belt

"It appears as a stream of especially conspicuous stars, beginning with Orion and including the brightest in Canis Major, Columba, Puppis, Carina, Crux. Centaurus, Lupus and the head of Scorpius . . ." B. A. Gould (1879)

GEORGE LOVI
Amateur Astronomer's Association
New York City



The region surrounding Orion and the winter Milky Way is shown beautifully in this long-exposure photograph made by Alan McClure. Canis Major and Sirius are at lower left, Procyon above, Orion at center right, Gemini at upper left, Taurus and Hyades at upper right.

IF WE VENTURE OUTDOORS on a brisk March evening and face south, our eyes will be greeted by the beautiful array of glittering stars which at once attracts our attention. Dominating the scene is the majestic constellation Orion, the mighty warrior, with his two bright first-magnitude stars, Betelgeuse and Rigel. Following him across the heavens are his two hounds, Canis Major and Canis Minor; the former contains the brightest star in the heavens—Sirius —and the rest of the constellation contains quite a few bright second-magnitude stars. Canis Minor holds claim to the first-magnitude star Procyon.

Then, if we allow our eyes to wander higher, we shall find the heavenly twins shining down on us—Gemini, with the two bright stars Castor and Pollux. Farther to the west and above Orion lies Taurus, with first-magnitude Aldebaran, and above Taurus and almost overhead is the brilliant yellow star Capella in Auriga, the charioteer. This portion of the sky is a star-gazer's paradise, and if we compare the brilliance of this region with that of the other portions that are simultaneously above the horizon we will notice quite a marked contrast in the grandeur of the stars.

It might also be noted that one of the reasons for the greater brilliancy which the stars of winter seem to exhibit is the fact that the transparency of the skies in winter is substantially greater than at any other time of the year. But, nevertheless, the winter stars are actually quite a bit brighter than those of other seasons. The clear winter air merely emphasizes this.

For most observers in the United States, Canis Major marks the southernmost portion of this area of bright stars. However, we can trace this celestial diamond necklace still further. To do so, let us take an imaginary trip down to New Zealand, where new stars will appear for us—stars which remain below our southern horizon here at home. We will go outside at about 9 p.m. during an evening in the latter part of March—the time when the first autumn leaves will begin to fall "down under." The accompanying star chart pictures for us just what stars we may see if we look up at the unfamiliar heavens of this part of the world. The chart has the compass points marked on the horizon and it can be used in the same manner as the regular star charts in this issue. For those of us who are accustomed to seeing the heavens only from North America, some acute confusion will result at first. However, if we direct our attention to the northwestern heavens we will immediately encounter Orion —but he will stand almost completely upside down! His two dogs continue to pursue him as always, but also in an inverted position. If we remember how the other constellations around Orion are oriented in respect to him, we should be able to locate them readily.

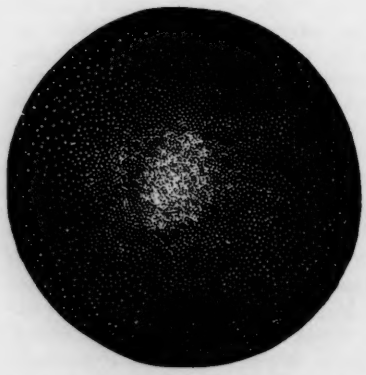
After we get our bearings in these strange skies, we can begin to explore a bit. If we permit our eyes to travel along in this direction we will immediately notice that a great many bright stars will greet us. We will at first notice the stars of Puppis, Carina, and Vela, which are, respectively, the stern, keel, and sail of the ship Argo. Originally, these three constellations, together with Pyxis (a faint group just east of Puppis), made up a single constellation called Argo Navis, the ship, but in this century astronomers have broken up this erstwhile but unwieldy star group into the four constellations which were just mentioned. These ex-Argo Navis stars will gleam down on us from overhead, and in Carina we can locate the dazzling star Canopus, the second brightest star in the heavens.

Canopus is actually far brighter than Sirius, but doesn't appear so because it is 100 light-years from us, whereas Sirius is only 8½ light-years away. If we continue along this belt of stars we will soon come to the Southern Cross, which has the name of Crux and lies about halfway up in the southeastern heavens. Despite its

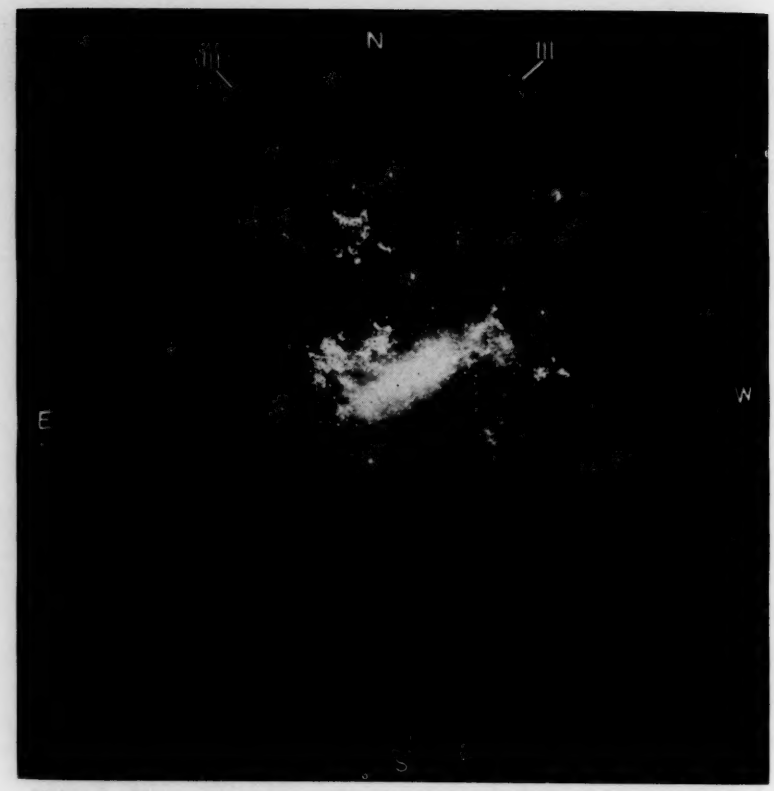
small size, this constellation boasts two first-magnitude stars and is of such spendor that it has been placed on the flags of at least two southern hemisphere countries and many postage stamps.

Not too many degrees below Crux shine two more first-magnitude stars, Agena and Alpha Centauri. As you may know, Alpha is the closest star to us next to the Sun (actually a faint telescopic star which revolves around it, Proxima Centauri, is really the closest, but only because its orbital position at present places it nearer to us than Alpha). Both Agena and Alpha Centauri are part of the huge constellation Centaurus, which itself has a fair number of bright stars. In addition it boasts the finest globular cluster in the heavens, Omega Centauri, which can be spotted on the chart just above the letter "A" in the word "Centaurus." As we continue along, we pass through Lupus, the wolf, and finally come to the familiar Scorpius, which has just risen and can be noticed sprawled along the southeastern horizon.

If we quickly look over this beautiful belt of bright stars from Orion to Scorpius, we may begin to envy the amateur observer down here in the southern hemisphere. Of course, we have the Big Dipper, but it hardly compensates for this glittering path of heavenly wonders, studded with many beautiful telescopic objects. This belt first attracted the attention of Sir John Herschel toward the middle of the last century, and he went to South Africa to explore those portions of the southern heavens which were inaccessible to his famous father, Sir William, back in England. Sir John's writings tell us that he often wondered about this bright string of stars, and he also marked the fact that it does not coincide exactly with the Milky Way, even though it seems to follow its general course through the heavens.



Omega Centauri, the king of the globular clusters, as drawn by a 19th-century astronomer using a medium-size telescope. From Celestial Atlas.



Nubecula Major—the Larger Magellanic Cloud. A prominent naked-eye object of the southern skies, this neighboring galaxy of our own can be located near the constellation Mensa, just west of the Milky Way in Mr. Lovi's chart on p. 4. This photograph, taken by ex-amateur and now professional astronomer Dr. H. M. Johnson, while studying its structure at the Mt. Stromlo Observatory in Australia. Condensation north of cloud (III) is composed of hot blue-white stars. Photo made by Johnson using an 8-inch Schmidt camera.

A GENERATION LATER, in 1879, the American astronomer Benjamin Apthorp Gould, who was director of Argentina's Cordoba Observatory at the time, also became interested in this belt of bright stars. He measured the positions of its principal stars and undertook to explain this phenomenon. He announced that this belt is not confined solely to the southern hemisphere, but extends completely around the celestial sphere. Although there is no such grouping of bright stars in the northern hemisphere to suggest its existence there, Gould stated that the belt includes the stars Vega, Altair, and Deneb, the principal stars in the constellations they are part of, as well as the principal stars in Cepheus, Cassiopeia, Perseus, Auriga, and Taurus. He also stated that the center line of this belt is tilted in respect to the plane of the Milky Way by some 20° and that this center line crosses the Milky Way in the constellations Crux and Cassiopeia. These two constellations are the two Milky Way constellations which are the closest to the celestial poles. Because of this, the orientation of this belt to the celestial sphere is such that, across the sky, it just precedes the Milky Way in the daily rotation of the heavens. Because of the research that Gould did on this celes-

tial band, astronomers have referred to it since as "Gould's Belt."

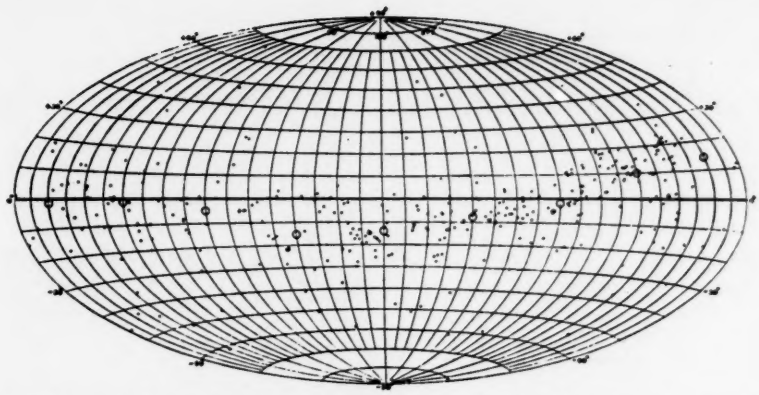
Gould saw in this belt evidence that our sun belonged to a "local cluster" of stars, similar to the Pleiades, a cluster which is a small assemblage of stars within the much vaster assemblage of our huge Milky Way system. However, he was unable to supply adequate data on the positions and distances of enough of these stars in space to show clearly that such a cluster exists.

Another rather interesting feature of this belt is the fact that the stars that make it up are predominantly blue in color. Earlier in this century, Dr. Harlow Shapley of Harvard College Observatory clearly showed that Gould's Belt is most closely delineated by the blue stars which are brighter than magnitude six. This phenomenon can be readily noticed by even the most casual stargazer, as bright blue and blue-white stars are very much in dominance here—stars such as Rigel, Canopus, and Sirius.

Many attempts have been made to associate this belt of stars with our position in space. The first major advance along these lines came during the days of Sir William Herschel. After laboriously counting the number of stars throughout various parts of the heavens in order to note how they are distributed, he announced that all the stars we see belong to a vast system which is shaped like a double-convex lens. He explained that, because of this, we see a hazy band of stars arching across our heavens, and he pointed out that this phenomenon is caused by the fact that when we look in its direction, we are actually looking in the direction of the edges of this vast flattened system. Because of perspective the stars seem to crowd upon each other and form a hazy band.

As a result of Herschel's new idea, this entire system thas was proposed by him later came to be called the "Milky Way system," or "galaxy" (from the Greek word "gala," meaning milk). This new idea became generally accepted. It was also believed that all the star clusters and nebulae that we see are members of this Milky Way system. Then Gould came along and tried to show that we are part of a star cluster, too, the principal members of which we see arched across our heavens in this band of bright stars.

During the twentieth century quite a bit of interesting research has been going on with respect to our Milky Way galaxy and where we lie within it. A pioneer in this field was Jacob C. Kapteyn, a Dutch astronomer who published a diagram in 1922 suggesting that our sun is located near the center of our galaxy. With the advent of the Mount Wilson 100-inch telescope and the discovery that Cepheid variable stars can be used to gauge the distances of nearer clusters and galaxies, astronomers in the twenties, largely through the work of Dr. Edwin P. Hubble of Mount Wilson, made the startling announcement that the spiral nebulae which are so numerous in our heavens are not members of our Milky Way system but galactic systems of their own! Further research with regard to the distribution of stars, star clouds and interstellar dust in our galaxy began to cast serious doubts on Kapteyn's proposal that we lie near the center of our galaxy, and gradually it became generally agreed that the sun occupied a less pretentious position toward the outer edge.



This chart shows the distribution of the hot, bluish-white (type B) stars brighter than the fifth magnitude in the vicinity of the Milky Way. These represent the stars of Gould's Belt, but the same type of stars fainter than the fifth magnitude fall back into line along the plane of our Galaxy. It is primarily a group of stars in Centaurus (below galactic equator) and in Orion (above) which show this deviation. If Gould's Belt of stars were a local cluster within Milky Way, star density should diminish evenly away from sun, but such has not proved the case as yet to satisfaction of most astronomers. (Diagram from "The Milky Way," Bok and Bok, Blakiston Co., 1941.)

Now, with the aid of radio astronomy, astronomers have begun to chart the positions of the spiral arms of our galaxy, the existence of which they had suspected ever since they found that the spiral nebulae were independent galaxies. By "tuning in" on the 21-centimeter-long radio waves that the abundantly distributed neutral hydrogen in our galaxy emits, astronomers have been able to penetrate regions where optical telescopes could not reach because of a screen of interstellar dust and gas. More and more, we are learning about the structure of our galaxy and our place within it. Step by step we are assembly the clues that suggest the answer to a riddle which, not too long ago, was considered to be forever beyond the ken of man.

In spite of all these spectacular findings, we have not yet been definitely able to associate Gould's Belt with anything concrete, either in terms of a local cluster or of anything else. It has never been seriously doubted that our sun belongs to some kind of local system, although it is not generally believed that we could be part of one as extensive as the Pleiades. It is quite likely that Gould's Belt is largely an effect of accidental perspective; that is, those stars which comprise it may by coincidence be positioned in space in such a manner that from our vantage point they seem to form this attractive band of stars.

But perhaps we ought to leave all these problems to the professional astronomer. Not knowing the true nature of something need not prevent us from enjoying it. So, even if we live up here in the northern hemisphere, let us during some cold, clear and crisp evening don our long woolens and warmest overcoat, and go outside—with or without a telescope. In the northern heavens we will see one of the finest portions of Gould's Belt, a region of the sky which can provide for us observing that is truly rewarding.

ASTRO-TOPICS

CONCERNING SOME MOONS . . . *wet, light, blue*

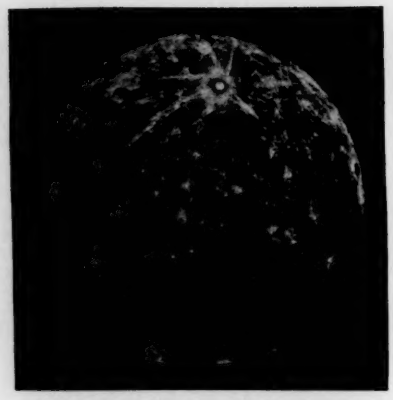
DR. I. M. LEVITT
Director, Fels Planetarium
Franklin Institute

THE CURRENT ATTENTION being accorded the moon in the space era brings to mind some of the absurd superstitions associated with it. The origin of many of the superstitions goes back to ancient times when the moon was primarily considered as a time-measuring body, and not a landing place. As a point of fact, our present calendar evolved from one closely tied to the moon.

The moon swings around the earth and goes through its phases once in 29½ days, following a path around the earth which lies close to the ecliptic, or path of the earth around the sun. This means that the moon, at different seasons, rises in different places along the eastern horizon and moves across the heavens at varying angles to the horizon. For example, in autumn the full moon rises in the east at a slight angle to the horizon. Most of the moon's path is not high in the sky but toward the south. As a result, the moon will rise on several successive nights at nearly the same time. This full moon, when the sun is at the autumnal equinox, is called the "harvest moon."

In olden days farm machinery was not available to harvest the ripened crops, so the whole family would pitch in—otherwise the crops might be ruined. If, for instance, the wheat were left out, it might get too ripe and fall to the ground. If a sudden storm would come up some other crops might mold. To forestall any such eventualities, farmers tried to gather the crops in quickly by working late at night. Light was essential for this operation, and this light was furnished by the full moon of autumn—hence the name of "harvest moon." A month later the retardation of the moon once more made night work possible but, since the crops were already in and no more farm work was required, the farmers used the moonlight to hunt for their winter meat supply—this moon was called the "hunter's moon."

Today we still hear of people who wouldn't think of sleeping outdoors at the time of the full moon. They are afraid of being moonstruck and going insane. This is a curious superstition, albeit a widespread one. The Latin word for moon is luna; the root of the word "lunacy" is the same. But just try to tell some believers that there is no connection between them. You cannot do it; the superstition is too widespread.

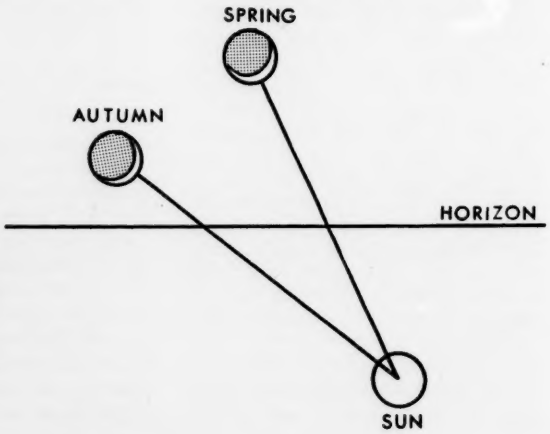


The moon has inspired man to great heights — and to extreme fancies. Dr. I. M. Levitt takes a winking and humorous look at things lunar and lunatic in this issue's "Astro-Topics" article. Photo courtesy of Lick Observatory.

How many know what constitutes a wet moon? Or a dry moon? In autumn the new moon is a thin crescent setting directly after the sun. Because the horns of the new moon at this time of year are almost perpendicular to the horizon (the ecliptic is at a low angle to the western horizon) if the moon were considered a saucer it would not hold water. Therefore, some people call this a dry moon, for if the moon cannot hold water the moon must necessarily be dry. Others will say that, if the moon cannot hold water, the water is running down the earth and is wetting it—therefore, it is a wet moon. Which is it? Take your pick.

In the springtime the horns of the crescent moon are pointed up and away from the horizon and, therefore, if the moon were considered a saucer, it would hold water. What kind of a moon is this? In this case some will say it is a wet moon, as any fool can plainly see. If you put water into a glass you wet the glass. The people who insist this is a wet moon will point out the fact that the month is April and in April we get April showers. The writer did a little research on this and went back some 90 years. He found the wettest month of the year was not April—it was August. And in August the horns of the crescent are in line with the horizon. If the April moon is a wet one, this August one must be the dry one. Is it? But some people say that *none* of the answers "hold water," so there we are!

Just as there is a harvest moon, so there is a planter's moon. In the spring some farmers will plant crops according to the phase of the moon.



Ecliptic lies at low angle to equator in autumn, high angle in spring; thus, angle of moon's cusps to horizon varies with seasons.

Here is another interesting superstition which has not been exploded. There are farmers within 100 miles of the Philadelphia area who would not, for an instant consider planting root crops like potatoes, carrots or beets at the time of full moon. They explain that the full moon will pull the crops out of the ground and ruin them. Other farmers will plant root crops in the full moon, saying the full phase of the moon will merely "tug" at the crops and make them grow better.

There was once an interesting piece of research done on this superstition. A scientist from the Midwest went down through the hills of Tennessee and Kentucky and collected these superstitions by the barrel. He returned to his little farm and proceeded to violate them one by one until he had demolished all of them. The pay-off came at the time of the state fair, when the scientist walked off with more prizes than he had a right to expect.

These are some of the superstitions which can be exploded, but there are certain types of moons which can be explained and do have a meaning. There is, for instance, the blue moon. In fact, there are two blue moons.

The reason for one blue moon lies in the fact that the calendar month and the month of the phases are not equal. A month—that is, the time from full moon to full moon—is approximately 29½ days in length. Occasionally a calendar month will begin with a full moon and at the end of the calendar month there will be a second full moon, as is the case in April of this year. This takes place about seven times in 19 years, so that "once in a blue moon" is not as rare as some people think.

The other blue moon is actually a moon which is blue in color—this has been observed by reputable scientists. In the case of this full moon the surface features of the moon remain visible, but the disc seems to be veiled with a thin, transparent blue lasting for several minutes at a time. It is particularly noticeable in the twilight and seems to disappear as the sky grows darker.

Many of the observations involve thin cirrostratus clouds, although it is usually stated that the moon itself, clear of clouds, still remained blue in color. This seems to refute the answer some scientists offer for this phenomenon: selective absorption, with the red light being scattered. At this moment science has no satisfactory answer to this riddle.

The University of Michigan's 85-foot radio telescope, located at Peach Mountain, Mich., will be visited by amateurs attending the 1961 Astronomical League-ALPO Convention in Detroit July 3-5. One of largest in the world, and a twin of the instrument at the National Radio Astronomy Observatory, the instrument is operated under a contract with the Office of Naval Research. Optical installations will also be inspected.

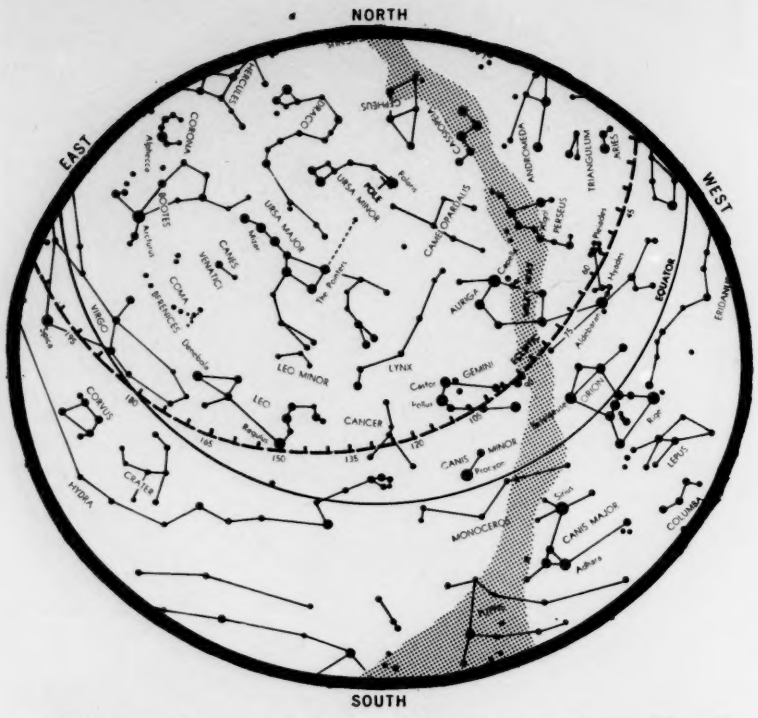
Detroit Society Host to 1961 League Convention

The Astronomical League, a federation of amateur societies across the United States, will hold its annual convention in Detroit, Mich., Friday, July 2, and the members will this year. Registration will begin on convene on Saturday, July 3. The meetings will continue through Monday, July 5. The Association of Lunar and Planetary Observers will also hold its meeting in conjunction with the League.

Convention sessions will cover both general topics and instruments, as well as a special session on planetary observing with members of the ALPO participating. Amateurs are invited to submit papers based on personal observations and research or on projects conducted by the writer. Papers should be a maximum of 15 minutes in length (10-minute time limit for junior session papers to allow more presentations). Papers should be submitted to program chairman E. C. Balch, 96 Farrand, Highland Park 3, Mich.: Mr. Balch will be happy to furnish a pamphlet, "How to Write a Convention Paper." ALPO papers should be submitted to Walter Haas, Pan-American College, Edinburg, Texas.

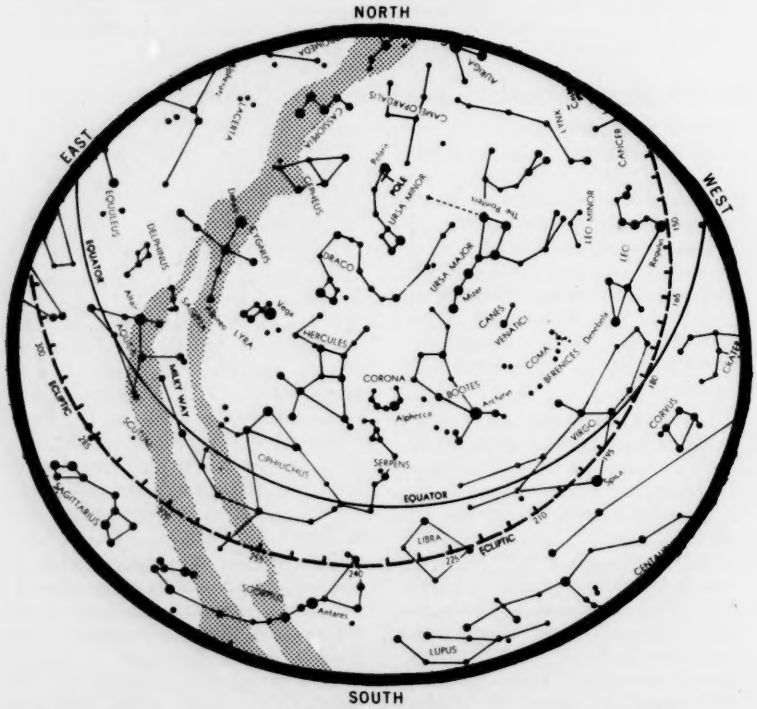
Highlights of the convention, which will be hosted by the Detroit Astronomical Society, will be talks on Saturday by the director of the nearby University of Michigan's director of its U. S. Navy radio telescope research project; by Dr. Helen Sawyer Hogg, authority on star clusters, at the Sunday evening honors banquet; and a field trip to the university's radio and optical telescopes at Peach Mountain.

Information on reservations, registration and other matters may be directed to general chairman C. D. Marshall, 17396 Westmoreland, Detroit 19, Mich. Residents of Canada should direct their requests to Edward Keith, 1995 Vimy, Windsor, Ontario.



10:00 p.m., Mar. 1 **9:00 p.m., Mar. 15** **8:00 p.m., Mar. 31**

Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.



5:00 a.m., Mar. 1 **4:00 a.m., Mar. 15** **3:00 a.m., Mar. 31**

SKY MAPS FOR MARCH

March skies are double-faced. The dominant constellations of winter still hold sway in the early evening, marching slowly into the western horizon as the hours pass. But the familiar Big Dipper, or Ursa Major, is once again taking its place near the zenith, the one constellation known to nearly everyone who has ever looked up at the stars. This heralds the advent of the spring family of star groups, and we shall follow Nature's suit and give way to the new with but a glance back over our shoulder at Orion and his lusty retinue of followers.

Gemini still belongs to us, though, and remains a dominant constellation for the next two months. Castor and Pollux, the heavenly twins—Pollux is slightly brighter and toward the north—form the head of this long and narrow zodiacal group, and from them two parallel strings of stars extend out to the southwest. Gemini is an interesting area for binoculars, with excellent starfields that do not suffer from overcrowding and confusion. Beware, though, of one "star" in Gemini—that bright red one. It's just visiting: Mars is the name.

Just east of Gemini sprawls Cancer, a weak figure for urban (and suburban) eyes but of interest primarily because of Praesepe, the great naked-eye cluster confined in the quadrilateral at the center of the constellation. Commonly known as the Bee Hive, this coarse galactic cluster was discovered as such 350 years ago by Galileo, who turned his "optick tube" on it and resolved the hazy patch into some 40 stars. Binoculars make it a wonderful sight—many amateurs recall the pleasure they had several years ago as they followed Uranus through its congested clutter of stars for several months.

Already riding high in the eastern sky is Leo, but we will beard the Lion in his den in April when it is high above us. For early risers there is much to see, as the morning map shows. The summer Milky Way is already giving us a hint of things to come, and a breath of warm summer balm that is not unwelcome. Scorpius and Sagittarius can be glimpsed in the southeast, while Cygnus and Lyra, not long gone from earlier evening skies, are climbing once again into the upper reaches of the heavens in the northeast. It's a mixed up world, these evening and morning skies of March.

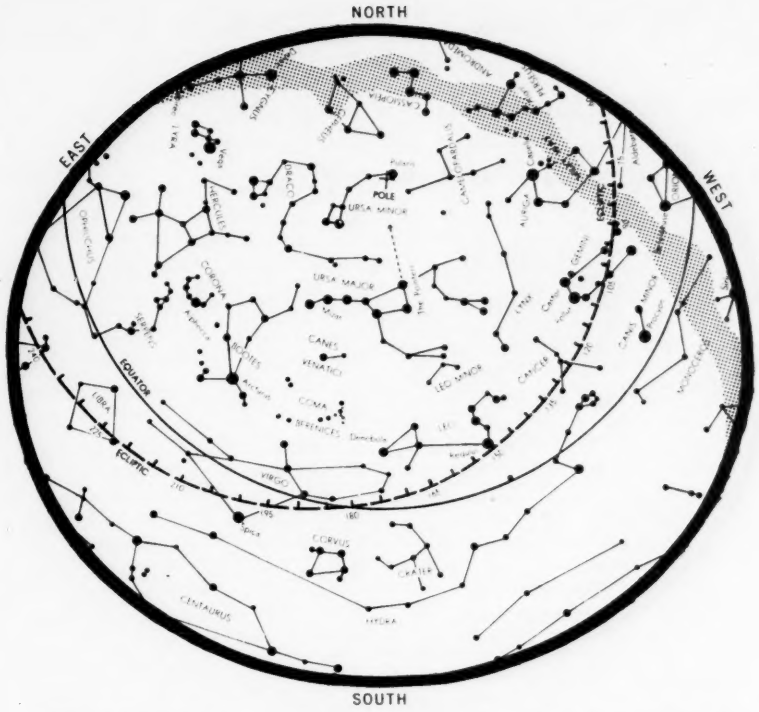
SKY MAPS FOR APRIL

By April, the spring star figures are very much in evidence, and the winter stars begin to disappear with the supper coffee. Although the daytime skies of April are usually clear, stratus clouds and showers often move in to frustrate the winterbound plans of expectant observers. Nevertheless, there is an excitement in April sky-watching.

Leo is now above us in the early evening, with bright Regulus and the Sickle of its great mane highlighting this rgoup. Regulus is almost exactly on the ecliptic, making it fair game for the occulting or conjoining moon and for close conjunctions with the planets. Later this year Uranus will pass quite close to it, just a few minutes of arc, in fact. Denebola, the bright star in the Lion's haunches, points the way to Hubble's "realm of the nebula," the region in Coma Berenices-Virgo-Leo haunted by the wispy band of distant galaxies embedded there. (A young man of our acquaintance, after hearing the above star used as a guide to locating this area of rich telescopic galaxies, insisted on calling this region the "realm of Denebola!")

Coma Berenices is a loose aggregation of stars to the east of Leo, an exciting string of broken pearls in binoculars. Also loosely defined, but held together by the 1st-magnitude Spica, is Virgo, which lies below Coma and Leo. Spica's yellowish-white rays illumine this sparse section of the southern heavens. Southwest of Spica is one of our favorite little constellations, and we don't know why. Its northern-most two stars—at the top of the little trapezoid—point toward Spica again, as if to distract you. It certainly doesn't look like the crow for which it is named—it just looks like Corvus to us, and perhaps that's why we like it.

Using the handle of the Dipper as our guide, as it curves to the southeast, we can easily locate Arcturus, the orange and flickering star at the tail of the long and narrow "kite" of Bootes. Beneath Bootes, and on its side, topples the Northern Crown, Corona, a rich little group that looks very much like a circlet of jewels. And still lower in the northeast, but pushing itself up into dominance once more, is Vega, the brightest of the summer stars. It is shaky and uncertain, and a bit diminished in brightness so low in the horizon, but it will have its day.



11:00 p.m. April 1 **10:00 p.m., April 15** **9:00 a.m., April 30**

Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

5:00 a.m., April 1 **4:00 a.m., April 15** **3:00 a.m., April 30**

XUM

The Human Factor In Astronomical Observing

MINICK RUSHTON
Atlanta Astronomical Society

THE AVERAGE AMATEUR astronomer takes great pains to insure that his equipment is of the best quality and yields accurate observational results. Yet, rarely does he consider the inaccuracy caused by psychological and physiological errors. The determination of these errors—and subsequent correction for them—would improve considerably the reliability of his results.

One such error is the systematic tendency to misjudge the midpoint of a line. This is particularly applicable to central meridian transit observations—such as an estimate of time of transit of a spot across Jupiter's central meridian—as the error may be as great as 10%. If an observer knew the degree of this tendency in his observations, he could apply a correction which would result in improved accuracy. This correction can be determined by "weighting it in" with the transit timings of other observers.

In the case of planetary detail, an observer who shows great sensitivity to linear detail tends to be below average in detecting faint spots and tone gradients, according to experiments made in Great Britain a half century ago. Often, great acuity in one visual facility is accompanied by a deficiency in the other two. This serves to explain, to some extent, why simultaneous drawings of the same object may vary greatly in appearance.

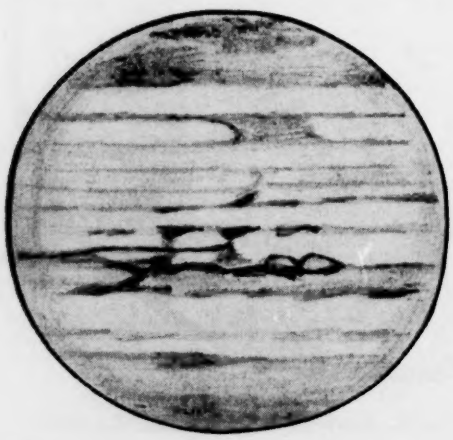
The average amateur knows well the limits of resolution and separation for his telescope, but, again, he is often ignorant of the limitations imposed by the eye. They are, however, quite simple. A spot may be glimpsed by the unaided eye when it is only 20-30 seconds of arc in diameter, although it must be at least twice as large as this in order to be definitely seen. However, for its shape to be apparent, its diameter must be two, or even three, minutes of arc.

There are many illusions common to objects near the threshold of illumination or resolution. A wavy line may seem straight and a line of spots may seem continuous. These illusions, it has been suggested, give the Martian "canals" their straight, continuous appearance, although it must be emphasized that this possibility cannot presently either be proved or disproved.

The importance of absolutely precise focus in planetary work cannot be over-emphasized. Some of the subjective effects of a slight displacement of telescopic focus have been investigated by the late Martian observer E. M. Antoniadi, who proposed an interesting explanation as to the nature of the Martian "lakes." He found that a slight focusing error, even as small as one-hundredth of an inch, could cause a single band to split into two partially overlapping bands, with only the darker core visible as an ill-defined black line. The intersection of such bands gives an appearance similar to the Martian "lakes." This effect could account for the many reports of gemination (doubling) in a number of the more prominent canal-like markings.

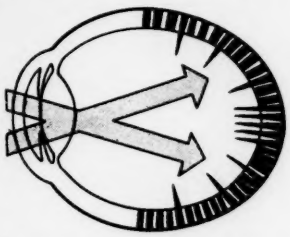
Among the factors which affect the visibility of an object, one of the most important is contrast. The contrast difference necessary for visibility is very low with a dark marking on a white background in a well-lit room, but it increases rapidly as the objects involved grow fainter. In the case of the night sky, for example, an area must be twice as bright as its background in order to be visible. Pushing the magnification of a telescope beyond its useful limit can reduce contrast and destroy delicate detail.

Perhaps the most important part of the personal element in observing is the sensitivitiy of the eye to illumination. Of this, the main factor is dark adaptation, which is due principally to the production of the visual purple, the substance which gives the rods in the retina their sensitivity to faint light. Although most of it is



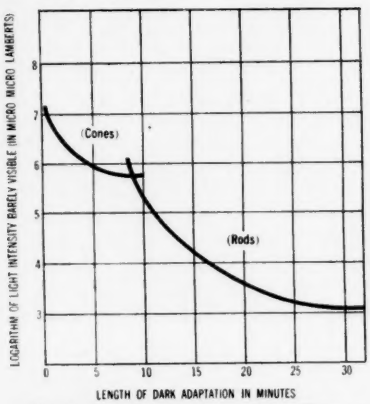
Estimate of times of transit of detail across central north-south meridian of Jupiter has long been an important activity of amateur observers, as has drawing of the disk. Physiological and psychological factors often work against the observer who is not conscious of these problems, however. Drawing by T. R. Cave.

produced within the first 20 minutes of dark adaptation, the final stage lasts nearly two hours. Since different individuals vary widely in their night-vision sensitivity, it should be



Cutaway view of human eye and retina shows idealized structure of cones and rods. "Rod" vision takes over from cones (concentrated at center of retina) when gaze is averted to improve night vision.

considered when one chooses a branch of observation in which to specialize. However, as variable-star observers will testify, considerable skill in detecting faint stars through "averted vision" can be developed through experience and training.



Chart, adapted from Air Force Manual "Night Vision Trainer," shows normal curve of dark adaptation. Threshold of cone efficiency is reached in ten minutes, after which rod vision increases sensitivity for more than half an hour.

Another factor to be considered is the nature of the background. The threshold of perceptible illumination may vary by as much as two magnitudes between a dark sky and one that is more or less luminous. If the sky is observed through a hole in a black screen to shut off general starlight and skylight—a condition similar to observation with a high-power eyepiece—magnitude 8.5 can be seen with the naked eye. This was demonstrated by H. D. Curtis at Lick Observatory many years ago, using a tube instead of a screen.

A REALISTIC PROJECTOR FOR ASTRONOMICAL SLIDES

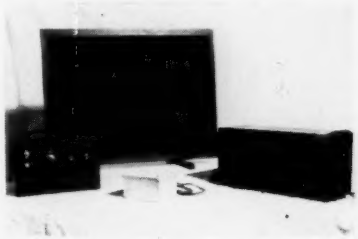
"It doesn't look much like the picture in my astronomy book," or "My, you can hardly see it," are familiar remarks heard by all amateurs when friends visit for an observing session at the telescope. It is difficult for people to understand that the pictures they see in books and magazines are the result of accumulated exposures of many hours on sensitive photographic plates and that the images have been enlarged many times in the reproduction.

With a considerable number of visitors coming to my own small observatory, I wondered if something couldn't be done to help them visualize the correct correlation of picture and telescopic image. The projection system described here comes closer to fulfilling the requirements than anything the writer has seen or heard about.

An old projection lens from a junk box was used to build a small projector, which is housed in a light-tight enclosure similar to those used in planetariums. Inasmuch as it was intended to be operated only in the observatory, at a close distance to a 14- x 20-inch screen, only a 50-watt projection lamp was needed. An external momentary-contact switch is desirable so the projector will be off when not in use, and, as the demonstrator must hold it down to project an image, it is not possible to forget to turn off the lamp and burn up either the slide or the bulb.

A small box was built which could be plugged into the circuit to the projector, and in this was placed a on-and-off toggle switch in parallel with the momentary contact switch. A large rheostat to the line provided a drop in the lamp voltage to produce a very dim image which, even in absolute darkness, still gave an uncomfortably bright image on the surface of my silvered screen.

During experiments to reduce the brightness of the image a small piece of black "coffin paper" was hung over the screen; the image immediately dimmed down to what appeared to me to be M31 as seen through an amateur's telescope. A slide of the Milky Way was the final test that proved the use of black coffin paper was ideal for the projection of star images. The moon was also realistically simulated, though not as good as the stars. However, the sun's image proved unsuitable on the black paper.



Snapshot above shows Wright's screen, control box (Variac may be substituted), and the light-tight box containing projector. Small metal box at center has dim light used to check slide before inserting in projector.

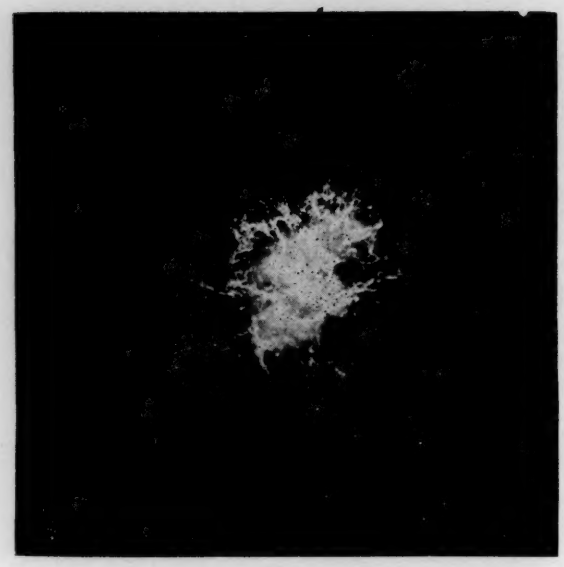
Flock-paper "cloth" may be obtained for $1.50 (24″ x 36″) from Edmund Scientific Co., Barrington, N. J.

As indicated above, the screen is very small, which is as it should be, since it emphasizes the point that objects as seen through a telescope are small.

The visual acuity of a group of observers can be demonstrated with such a projection system and this was shown at a discussion group of the National Capital Astronomers. The *silvered* side of the projection screen was facing toward the group when the lights were turned out, but in the darkness, before turning on the projector, the screen was reversed to place the *coffin paper* side toward the audience. When the projector was operated with the lamp dimmed, comments from the assembly indicated immediately those members who spent the most hours at their telescopes. Of the 35 present only about three could see an object on the screen, but as the light was gradually increased others began to see the image. All felt it was a good demonstration of how difficult it can be to locate faint, nebulous objects in the sky, especially for the inexperienced or occasional observer. This type of projection can possibly be used to train observers in detecting faint celestial objects.

G. R. Wright
National Capital Astronomers
Washington, D. C.

XUM



The Crab nebula in Taurus, long known to be the remnant shell of an historically recorded nova, has taken on new interest to astronomers as a celestial radio source. Interesting prey in a 3-inch, it may be located near Zeta Tauri (M 1) on the charts on p. 23 of this issue. (Mt. Wilson-Palomar.)

THROUGH THE THREE-INCH

BEFORE RAMBLING with our three-inch, we would like to reprint—as an answer to a number of inquiries—our original "statement of purpose" regarding this little feature. Apparently some telescope owners have felt left out, since they own 4-inch or 6-inch instruments. The term "3-inch," as we use it, is less a measure of aperture than it is an attitude of mind. As we stated one year ago:

"Throughout the literature of astronomical observation you will read the "confessions" of experienced observers, in which they bare to the world the fact that, although they proudly claim ownership of large and impressive telescopes, much of their observations over the years have been made with modest instruments. Probably the most dramatic and purposeful use of a small telescope was that of the 3-inch glass used by Argelander a century ago to compile the famous chart and catalog called the *Bonner Durchmusterung*. With this small refractor and the assistance of a few recorders, Argelander observed and charted the positions and magnitudes of 324,000 stars! The BD, as it is referred to, was recently reprinted for the second time since its initial publication—a testimony to its continuing value.

"But—you say—*your* small telescope shall never fall heir to such a disciplined program as this. Your intentions are humble, and your telescope is the same? Good, for humility is at home beneath the canopy of stars, and a three-inch telescope can keep you occupied for the rest of your life. For remember, a telescope itself sees nothing, but with an intelligent and searching eye attached even a modest instrument can become a literal "window on the heavens" to view the infinite parade that passes by.

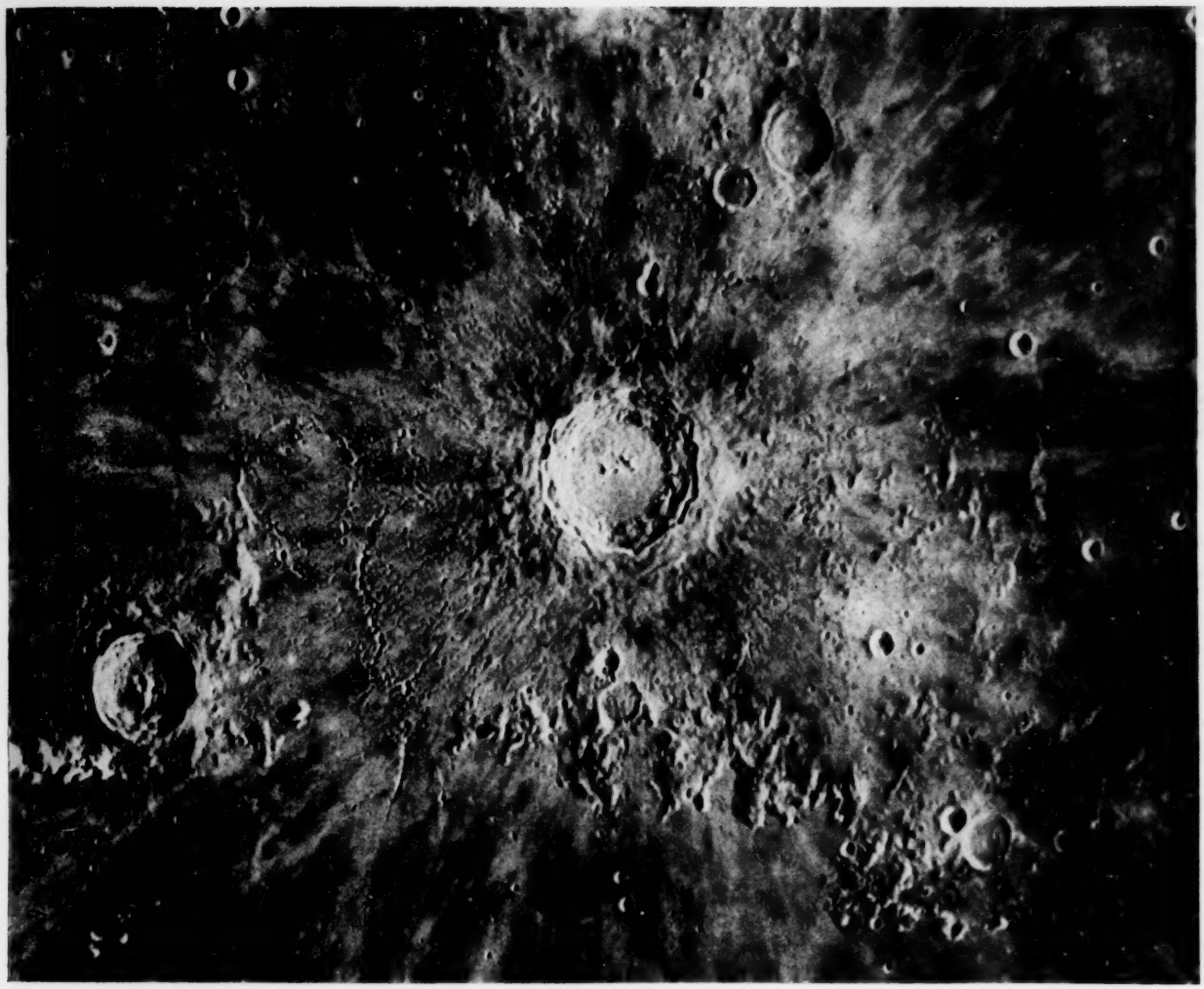
"In fact, the ease of use inherent in the small refractor or reflector places it in a class of its own. During recent years the writer has used or still uses such varied instruments as a 4-inch and a 5-inch refractor and an 8-inch and 10-inch reflector, and, he hopes, with good purpose. Yet, the demands of life's pace intervene, and he continues to find himself catching fleeting moments under the stars in the company of a small 3-inch refractor. Light, steady and sure, it can be picked up in a moment and carried out into the shadows of the house, and is quite capable of dodging a neighbor's light or seeing around an interfering tree.

"It's a splendid instrument! Fashioned in the early half of the 19th century by Henry Fitz of New York City, its object glass produces perfect diffraction rings about a star on steady nights. The fine yellow brass of its fixtures, the delicate taper of its dark mahogany tube, and the proud script of its maker's name all attest further to the craft which went into it. Had Henry Fitz lived to compete with the fabled Clarks of Cambridgeport, his name would perhaps be even better known.

"During the brief ten years of this partnership, the writer has often wondered as to the previous century of the telescope's use. How many lifetimes has it filled with excitement and pleasure, and whose? What devious route has it traveled from Fitz' workshop in lower Manhattan to its present resting place in a suburban patio? Its optics are a bridge across the years, by which its user can share his present pleasures with the past, both in space and in time.

"Of course, this is all very well but —unlike some of the other products of man's efforts to tap nature's secrets—vintage and the aging process do not necessarily guarantee quality in an optical instrument. It is quite proper to respect a piece of fine optical craftsmanship and to revere its service, but it is still the use to which it is put and the pleasure it brings that are the final measure of the glass.

"Many excellent telescopes are available to the amateur astronomer today. There are more good telescopes on the market now than ever before. The best mirrors and lenses still require special attention and hand working, but modern techniques have eliminated much of the need for the long hours of painstaking drudgery—hours which often only allowed the artisan more time to compound his errors.



No celestial object unfolds more of its secrets to a small telescope than the moon. A 3-inch can nearly equal the detail surrounding the lunar ringed plain Copernicus that has been caught here by the photographic eye of the Lick 36-inch refractor.

"Now, when in the future we refer to "the three-inch," we will be speaking in general terms—speaking of any modest telescope, reflector or refractor, with which we are at home and which we can move about with ease. Its aperture will be unassuming—two to four inches, perhaps, although we will not snub the fives and sixes if they behave themselves—and we won't push the powers too high. Three inches and a 40-power eyepiece are a combination guaranteed to unlock a lifetime of celestial riches."

* * *

With the coming of spring, the telescopist must search a bit for his heavenly bounty. The rich star fields of winter wheel quickly to the west, and the glory of the Galaxy of midsummer is still just a memory or a hope. This is all very well. The amateur observer is often inclined to become fat and lazy, reaching out again and again for the habit-forming objects that are easy and common and much-observed. Naturally, he wants to view objects within the range of his small instrument, but these "show objects" soon pall and, with them, the amateur's interest. We suggest that he turn left at Mizar and stretch out on his own to do a little rooting and browsing.

Norton's Star Atlas, or the small field edition of the *Skalnate Pleso Atlas of the Heavens* with an appropriate guide such as the *Field Book of the Skies*, can send you off on some offbeat excursions with your telescope. Spring skies also afford the novice a chance to get his feet wet (literally) without going in over his head in the deeper star fields that pervade the heavens at other times of the year.

For example, there are the doubles. Now, not for one moment are we going to suggest that you snub old friends. Cor Caroli (Alpha Canes Venatici), which lies between the bowl of the Dipper and Arcturus, is always lovely in low power; and who are we to cast aspersions on Gamma Leonis, tight and trim in a small glass, even at high power. But there are other places to go, other doubles

An asteroid leaves its tell-tale record on the photographic plate. This object, fairly bright, was caught during an exposure guided on the stars. Faint asteroids are often picked up by cameras guided on the supposed orbit of the asteroid itself, allowing the stars to trail and the faint light of the asteroid to build up on the plate. Harvard College Observatory photograph.

to see. The elder Otto Struve and F. Struve, working at the Pulkova Observatory in Russia many years ago, catalogued many thousands of fainter doubles, both in their own lists and in the Pulkova Catalogue of doubles. *Norton's* designates these on its charts using the capital Greek letter sigma, and this usually signals a productive detour to the alert observer when he encounters a Struve number along his route. Most of these doubles are within reach of a modest objective or mirror, and there is some additional excitement in knowing that you are treading where only a handful of amateurs have trespassed since the days of the earlier Struves. Also, you will seldom if ever have charts which show most of the stars you will see with your telescope, so searching for these lesser doubles gives you practice in star-hopping—picking out the significant "landmarks" among the stars that can lead you from the familiar to the new and unexplored. The skies of spring give you a better chance—star-hopping in the Milky Way is a project for the more experienced star-gazer, which you can quickly become with a little practice.

Go on your way. Pick yourself a reason for starting out, then explore and examine along the way, always relating what you encounter to the star chart. Heedless and haphazard observing quickly becomes a drudge. We've personally staked out our claims on a dozen areas of the sky or more—selfish little grants of sky we have given ourselves for unencumbered sky-roving. We're not about to tell you where they are, either, and have you come in and "hunt them out." Many of them were picked up in the days when our budget of time matched the purse of our enthusiasm—along the by-ways to a variable star field, or while checking the regions assigned to us in Auriga by the American Association of Variable Star Observer's nova search program. (We have discovered one—not actually, although we did for a few hours, with witnesses, but a later check revealed that our "new star" was merely the product of a bad night for Argelander during his compilation of the great *Bonner Durchmusterung* charts; this disappointment was relayed to us by our father at 4:00 a.m., who received this intelligence from a group of amateurs in a car parked rather noisily in front of our home. The fact that fame and glory had nearly descended on his household failed to impress him.)

There are many roads for you to follow. Delta Geminorum, near which Pluto was discovered three decades ago, is a good turn-off point. Delta itself is an interesting double of about 6″ of arc separation; the companion is about 8th magnitude. To the west a few jumps of a low-power field can be spotted a number of wide optical doubles, plus two or three stars from the Struve list, all of them resolvable on a good night with medium powers. In the vicinity, and dominating the fainter stars, is a little asterism shaped much like the constellation Perseus. At one side of this, as you will spot on your chart, is an object bearing Herschel's classification H IV, indicating that it is a bright planetary nebula. It is also listed in Dreyer's *New General Catalogue* (NGC) as 2392, a designation more common these days than the old, but more descriptive, Herschel listing.

HAVE YOU REALLY SEEN THE MILKY WAY?

Carnegie Institution, Washington

You will . . . with this ANRA 4¼-inch Rich-Field Telescope! As you sweep the winter skies with this compact, wide-field instrument, you'll feel that you've seen the heavens for the first time. The Pleiades . . . the Auriga clusters . . . the Milky Way in Canis Major — these and countless sights can be yours nightly through the eyepiece of an ANRA Rich-Field Telescope. It's ready for use in a moment . . . just cradle it in your arms!

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NGC 2392 is about the size of Mars at its greatest opposition angular diameter (25″ of arc), but it is slightly off the round. Can you glimpse the faint star at the center? It is only of the 10th magnitude, but the wispy shell of gas in the planetary cuts down on background contrast, and the object itself causes some distress, since it is one of the brighter planetaries at about 8th magnitude. This makes it a whole magnitude brighter than the Ring nebula in Lyra, which is difficult to accept. However, the Ring nebula (M 57) is sharply defined, and some three times larger than NGC 2392. Besides, it is difficult to estimate accurately the visual magnitude of extended objects such as these.

So we recommend that you take to the open road and stake yourself out a claim to an acre or two of your own in space. It's going fast these days.

There's another bit of uselessness that we highly recommend to you and your small telescope—the tracking of minor planets. Most of them are faint, you can't see a thing when you find one, and the professionals aren't the least bit interested to hear that you did. Fact is, they might become downright belligerent about it if you accidentally discovered a new one, because it would just add to their troubles in keeping up with the ones already classified and catalogued. Of course, if it made a very near approach to the earth and allowed observations to be made which would improve our knowledge of solar system distances, they'd be all for it, but aside from this small chance there is no earthly use to asteroids, at least for the amateur. But the amateur astronomer is not one to worry about earthly things, and for just plain enjoyment—and some excellent training in using charts—minor planets can be a major attraction.

We announced in the last issue that we would begin a feature on asteroids in this issue of THE REVIEW OF POPULAR ASTRONOMY. Unfortunately, the basic data arrived from the U.S.S.R. (a project assigned to its astronomers by the International Astronomical Union) too late for transcription and transmissal by the Minor Planet Center of the IAU at the Cincinnati Observatory. Dr. Paul Herget kindly rushed copies to us and to Walter Houston, who has volunteered to preside over this useless department, but Mr. Houston had no time to prepare

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the feature for this issue. We will list the brighter asteroids which come to opposition during March and April in this department for now, then turn things over to the capable W. S. H. in May and forevermore. The department will include techniques of observation, comments on interesting asteroids, current ephemerides, and charts of the brighter objects. We also recommend the chapter on asteroids in *The Handbook of the Heavens*, available at newsstands as a paperback in the Mentor series and as a hardback from McGraw-Hill. Packed with minor-planet information for the amateur.

The ephemerides below gives the right ascension and declination (1961) for ten-day periods around opposition. Column at left gives month and day of each ten-day position. Above each ephemeris is given the asteroid number, its name, the date of opposition, and its approximate magnitude at that time. Positions are for Oh Universal Time on the given date. (Incidentally, a good chart for following asteroids—although allowance for precession has to be made in using it, since it was designed for 1920 coordinates—is the Beyer-Graff *Stern-Atlas*. It can be obtained in this country from the Stechert-Hafner booksellers in New York City for about $15.00. The *Skalnate Pleso* atlas will also serve the purpose, although it does not show the faint stars of the Beyer-Graff charts.)

BRIGHT MINOR PLANETS
March-April 1961

Date		RA h	m	Dec °	′
	62 Ausonia 2/20 11m1				
1	31	10	32.3	+11	12
2	10	10	23.5	+11	42
	20	10	13.3	+12	16
3	2	10	02.9	+12	48
	12	9	53.4	+13	13
	22	9	46.0	+13	26
	11 Parthenope 3/29 10m8				
3	2	12	51.3	+ 0	44
	12	12	45.1	+ 1	48
	22	12	37.2	+ 2	57
4	1	12	28.4	+ 4	05
	11	12	19.8	+ 5	04
	21	12	12.5	+ 5	48
	129 Antigone 4/1 10m6				
3	12	12	55.1	+ 9	21
	22	12	49.1	+11	02
4	1	12	42.0	+12	35
	11	12	34.7	+13	50
	21	12	28.3	+14	40
5	1	12	23.7	+14	58
	17 Thetis 4/25 10m8				
4	1	14	29.1	− 4	44
	11	14	22.8	− 3	44
	21	14	14.6	− 2	45
5	1	14	05.8	− 1	56
	11	13	57.6	− 1	24
	21	13	51.1	− 1	12
	405 Thia 5/9 11m0				
4	11	15	19.3	−32	13
	21	15	15.1	−31	18
5	1	15	08.5	−29	52
	11	15	00.8	−27	59
	21	14	53.7	−25	51
	31	14	48.7	−23	42
	10 Hygeia 5/15 10m0				
4	21	15	44.5	−24	34
5	1	15	38.0	−24	14
	11	15	30.3	−23	44
	21	15	22.1	−23	06
	31	15	14.5	−22	25
6	10	15	07.5	−21	45

Just off the tip of the handle of the Big Dipper, and in the general direction of Alpha Canes Venatici, is an interesting object, the Whirlpool nebula, Messier 51. With an atlas you can work your way over from Eta Ursa Majoris (end star in the Dipper handle), and a 3-inch picks it up quickly if its user's eyes are dark-adapted. Don't use an uncovered flashlight—sheath it in red

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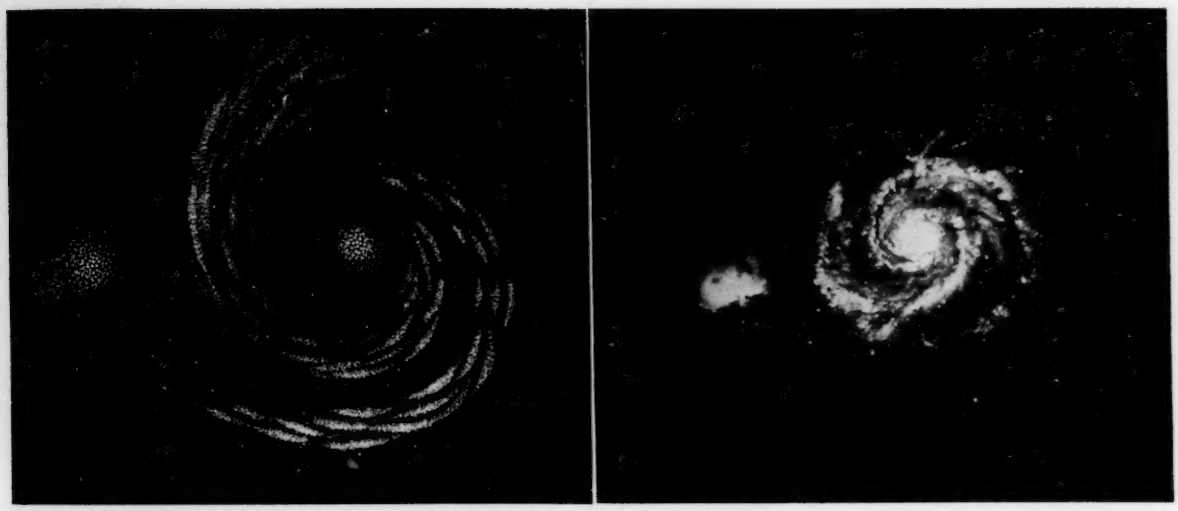

(Left) A drawing by Lord Rosse of Messier 51 in Canes Venatici, from a plate in Mitchel's "Planetary and Stellar Worlds." Compare this to 200-inch photograph (right) of same object. Neighboring galaxy at left is NGC 5195. (Mt. Wilson and Palomar Observatories).

cellophane if you are using charts. You'll never see anything, otherwise. A larger instrument shows an adjoining spiral galaxy, NGC 5195, which seems to be a physical part of one of the spiral arms of the primary object, but we cannot be certain that this is not an optical association. As the photograph shows, we are seeing this bright (7.4) external galaxy from a distance of nearly eight million light-years, so you can give a fairly exact figure to your friends when they ask how far you can see with your telescope. The writer has seen this object give a hint of its spiral structure in a large (16-inch) refractor, and a medium-sized instrument will show NGC 5195, its neighbor, as a bright knot near the edge of the oval.

Now, let's get the winter aches out of our instruments and take them out into the spring skies for a stroll. And don't bother to stay on the straight and narrow. The first one to Mizar and Alcor is a sissy!

D.D.Z.

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An intruder flashes across the summer Milky Way in Cygnus, stealing the show from the delicate traceries of the Network nebula. This meteor path shows several peaks of brightness, as indicated by its varying width.

Yerkes Observatory Photograph

METEOR FRAGMENTS

By Edwin E. Friton

MARCH OFFERS nothing in the way of major meteor showers—just a few minor ones with very low rates. Nevertheless, the serious observer will do his best to get in a few nights of observing to increase the statistics in these fallow periods. The weather is usually not amiable in mid-north and higher latitudes, so any opportunity seized upon at this time will prove all the more valuable.

April nights are not as formidable, and there is one fairly good shower, the Lyrids, which is classified as major. There will not be too much moonlight this year, as the moon will be at first quarter, setting at midnight on the 20th-21st and before 1:00 a.m. on the following night. The maximum of the Lyrids is due at 10 p.m. CST on the 21st, according to P. M. Millman in the RASC *Handbook*. (This may vary by several hours, as is usual with meteor showers.) The radiant is given here as R.A. $18^h\ 16^m$, Dec. 34° N., which is just at the border between Lyra and Hercules. This radiant, or area from which these meteors appear to come, is about 6° southwest of Vega.

It is interesting to note that various Lyrid shower radiants have been found over the years by a number of investigators. Lovell, in *Meteor Astronomy*, gives tables in which the locations range from 18^h to $18^h\ 46^m$ in R.A. and from 30° to 45° in declination. It is quite clear that we have here a shower with multiple radiants, some of which are in Lyra and some in Hercules. The Lyrids are swift and often leave streaks. The rate of *all* meteors on this shower date is usually about 15 per hour at maximum. However, in the past, there have been occasional records of high rates, such as 167 in 15 minutes in 1803 and 96 per hour in 1922. These unaccountable variations, and the fact that there is a multiplicity of radiants, make it quite important to observe this shower further. According to J. P. M. Prentice, reporting to the British Astronomical Association, the rich portion of the stream is quite narrow, giving a sharp, well-defined maximum.

Lyra will be in the northeast sky during the evening hours, and will be nearly overhead at 4 p.m.. in middle northern latitudes; therefore the best rates will probably be seen after midnight on April 21-22. Please send your counts and observations to me at 508 Marshall Ave., Webster Groves 19, Mo., or to this magazine. They will be sent to the proper regional director for processing and forwarding to the American Meteor Society. Proper form for reporting meteor counts was given on p. 13 of the July-August 1960 issue of the Monthly Evening Sky Map.

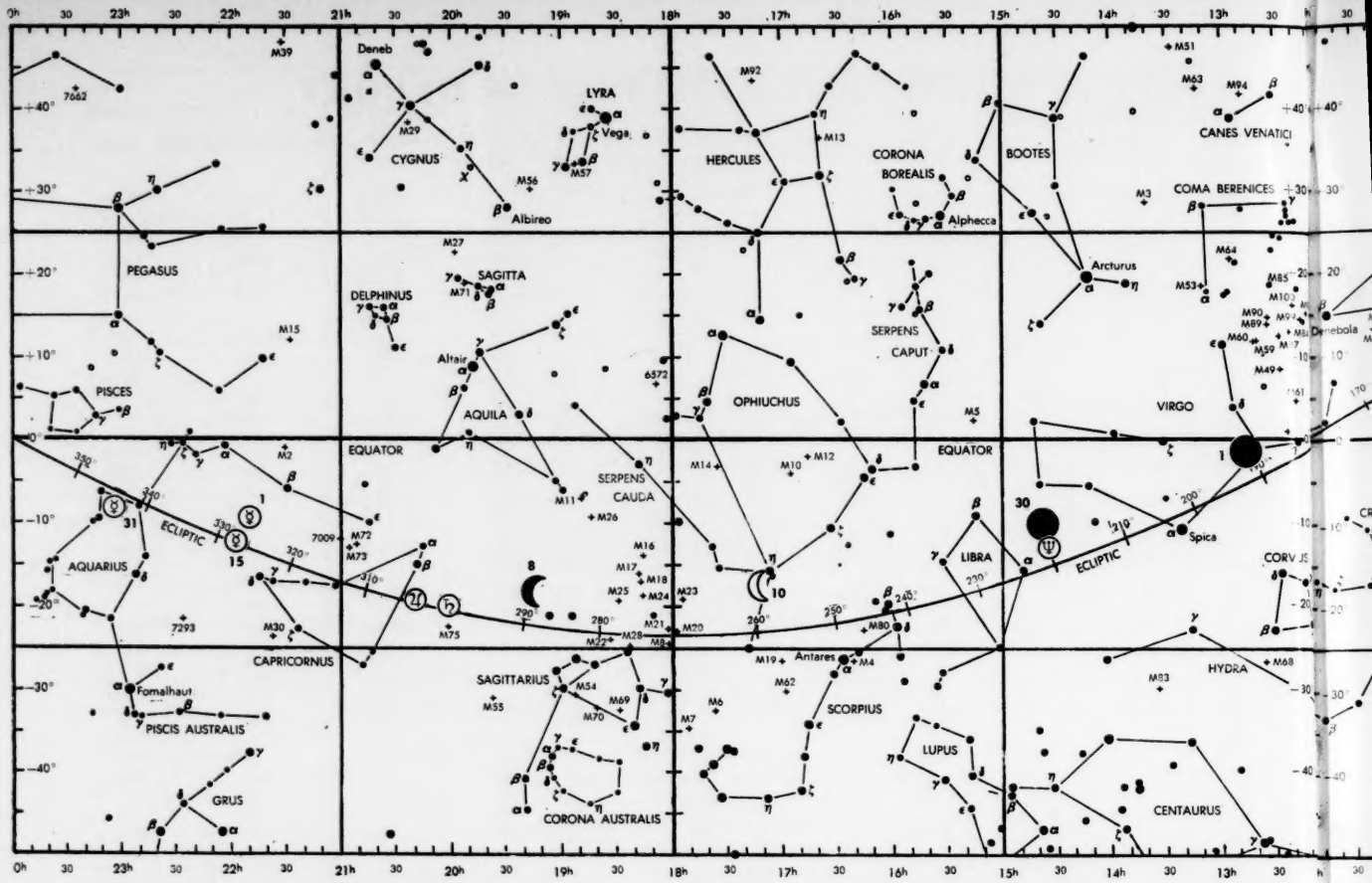
EARTH SATELLITE STATUS REPORT

(This official listing by the National Space Surveillance Control Center of the Air Research and Development Command does not include any U.S. or U.S.S.R. satellite or probes launched after Dec. 6, 1960.)

SATELLITES IN ORBIT		Source	Launch	Period (minutes)	Apogee Statute Miles	Perigee
1958 ALPHA	Explorer I	US	1 Feb. 58	107.2	1155	217
1958 BETA I	Rocket Body	US	17 Mar. 58	138.3	2687	406
1958 BETA II	Vanguard I	US	17 Mar. 58	133.8	2447	405
1959 ALPHA I	Vanguard II	US	17 Feb. 59	125.4	2049	348
1959 ALPHA II	Rocket Body	US	17 Feb. 59	129.6	2279	344
1959 DELTA	Explorer VI	US	7 Aug. 59	(position uncertain)		
1959 EPSILON II	Capsule	US	13 Aug. 59	94.2	470	123
1959 ETA	Vanguard III	US	18 Sep. 59	129.8	2313	320
1959 IOTA I	Explorer VII	US	13 Oct. 59	101.1	671	344
1959 IOTA II	Rocket Body	US	13 Oct. 59	101.0	662	343
1960 BETA I	Rocket Body	US	1 Apr. 60	99.1	465	429
1960 BETA II	Tiros I	US	1 Apr. 60	99.1	467	429
1960 GAMMA I	Rocket Body	US	13 Apr. 60	93.2	363	179
1960 GAMMA II	Transit IB	US	13 Apr. 60	95.2	426	238
1960 EPSILON I	Sputnik IV	USSR	15 May 60	93.4	372	175
1960 EPSILON III	Metal Object	USSR	15 May 60	93.8	397	172
1960 EPSILON IV	Metal Object	USSR	15 May 60	93.4	371	176
1960 ZETA I	Midas II	US	24 May 60	94.3	315	300
1960 ETA I	Transit I	US	22 June 60	101.6	650	389
1960 ETA II	Greb	US	22 June 60	101.6	657	381
1960 ETA III	Rocket Body	US	22 June 60	101.3	638	383
1960 IOTA I	Echo I	US	12 Aug. 60	117.5	1324	628
1960 IOTA II	Rocket Body	US	12 Aug. 60	118.0	1031	950
1960 IOTA III	Metal Object	US	12 Aug. 60	118.2	1050	941
1960 IOTA IV	Metal Object	US	12 Aug. 60	118.2	1044	950
1960 IOTA V	Metal Object	US	12 Aug. 60	118.3	1060	940
1960 NU I	Courier IB	US	4 Oct. 60	106.8	767	586
1960 NU II	Rocket Body	US	4 Oct. 60	106.4	736	591
1960 XI I	Explorer VIII	US	3 Nov. 60	112.6	1420	259
1960 XI II	Rocket Body	US	3 Nov. 60	112.6	1419	259
1960 OMICRON	Discoverer XVII	US	12 Nov. 60	94.2	478	114
1960 PI I	Tiros II	US	23 Nov. 60	98.1	459	378
1960 PI II	Rocket Body	US	23 Nov. 60	98.1	456	378

LUNAR AND SPACE PROBES		Source	Launch	Status
PIONEER IV		US	3 Mar. 59	Orbiting Sun
LUNIK I	(Mechta)	USSR	2 Jan. 59	Orbiting Sun
LUNIK II		USSR	12 Sep. 59	Hit Moon—13 Sep. 59
PIONEER V	(60 Alpha)	US	11 Mar. 60	Orbiting Sun

DECAYED SATELLITES		Source	Launch	Down
1957 ALPHA I	Rocket Body	USSR	4 Oct. 57	1 Dec. 57
1957 ALPHA II	Sputnik I	USSR	4 Oct. 57	Early Jan. 58
1957 BETA	Sputnik II	USSR	3 Nov. 57	14 Apr. 58
1958 GAMMA	Explorer III	US	26 Mar. 58	28 Jun. 58
1958 DELTA I	Rocket Body	USSR	15 May 58	3 Dec. 58
1958 DELTA II	Sputnik III	USSR	15 May 58	6 Apr. 60
1958 EPSILON	Explorer IV	US	26 Jul. 58	23 Oct. 59
1958 ZETA	Atlas	US	18 Dec. 58	21 Jan. 59
1959 BETA	Discoverer I	US	28 Feb. 59	Early Mar. 59
1959 GAMMA	Discoverer II	US	13 Apr. 59	26 Apr. 59
1959 EPSILON I	Discoverer V	US	13 Aug. 59	28 Sep. 59
1959 ZETA	Discoverer VI	US	19 Aug. 59	20 Oct. 59
1959 THETA	Lunik III	USSR	4 Oct. 59	About 20 Apr. 60
1959 KAPPA	Discoverer VII	US	7 Nov. 59	26 Nov. 59
1959 LAMBDA	Discoverer VIII	US	20 Nov. 59	8 Mar. 60
1960 DELTA	Discoverer XI	US	15 Ap. 60	26 Apr. 60
1960 EPSILON II	Rocket Body	USSR	15 May 60	17 Jul. 60
1960 LAMBDA I	Sputnik V	USSR	19 Aug. 60	20 Aug. 60
1960 KAPPA	Discoverer XIV	US	18 Aug. 60	15 Sep. 60
1960 LAMBDA II	Rocket Body	USSR	19 Aug. 60	23 Sep. 60
1960 EPSILON VII	Metal Object	USSR	15 May 60	24 Sep. 60
1960 EPSILON V	Metal Object	USSR	15 May 60	Sep.-Oct. 60
1960 EPSILON VI	Metal Object	USSR	15 May 60	Sep.-Oct. 60
1960 EPSILON VIII	Metal Object	USSR	15 May 60	Sep.-Oct. 60
1960 EPSILON IX	Metal Object	USSR	15 May 60	Sep.-Oct. 60
1960 MU	Discoverer XV	US	13 Sep. 60	17 Oct. 60
1960 GAMMA III	Metal Object	US	13 Apr. 60	Early July 60
1960 THETA	Discoverer XIII	US	10 Aug. 60	14 Nov. 60
1960 RHO I	Sputnik VI	USSR	1 Dec. 60	2 Dec. 60
1960 RHO II	Rocket Body	US	1 Dec. 60	2 Dec. 60
1960 ZETA II	Metal Object	US	24 May 60	5 Dec. 60



EQUATORIAL SKY MAP

The charts on these pages show the star field from the equator to 50° south and 50° north. Right ascension is measured from west to east in hours; each notch at the top and bottom of the charts represents 10m of right ascension. Declination is measured to the north and south of the equator in degrees plus or minus; each notch at the right and left of the chart represents 5° of declination. Longitude along ecliptic is measured in 10° segments.

MARCH AND APRIL AMONG THE PLANETS

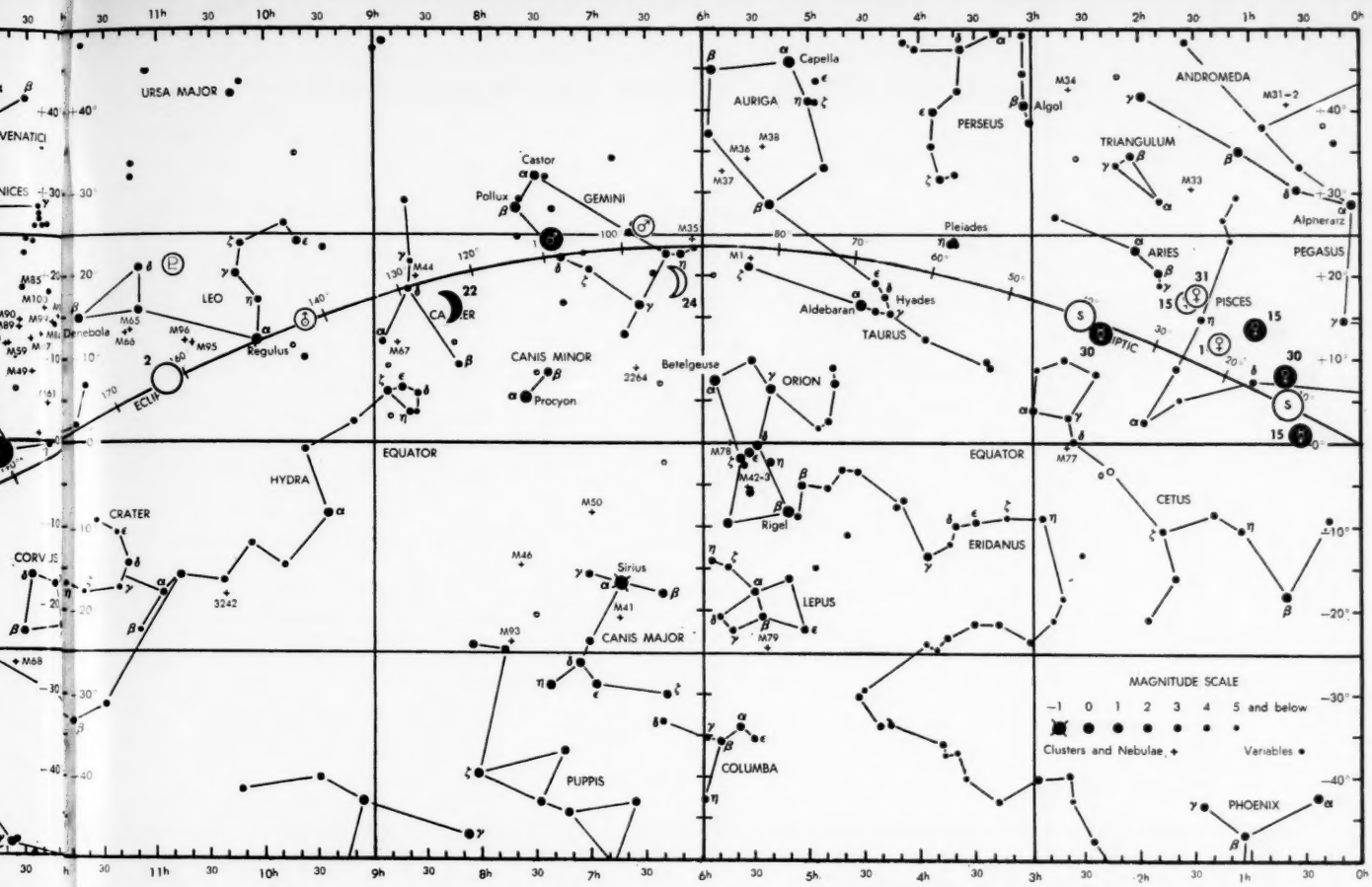
SUN: The sun begins March in Aquarius, but soon passes into Pisces. In the middle of April the sun enters Aries. Of course, a reincarnated astrologer would have a difficult time accounting for this, for he would know very well that spring begins on March 20th or 21st (March 20th this year), when the sun enters "the house of Aries." Not understanding precession—the gyroscopic effect of the earth's polar rotation which causes the solstices and the equinoxes to move to the westward—he would be hard put to explain why spring, in his mind signalled by the sun's arrival at Aries, was a little late this year. Actually, the astrological "house of Aries" has moved next door into the constellation of Pisces. As for explaining off the late spring, our ancient astrologer wouldn't have such a hard time explaining that to any Midwesterner or Easterner *this* year.

THE MOON: In March full moon is on the 2nd; last quarter on the 9th; new moon on th 16th; first quarter on the 23rd. In April, we will enjoy what should really be called the "lovers' moon"—two full moons in one month, a rather rare occurrence (see "Astro-Topics," p. 8). The first full moon is on the 1st; last quarter on the 8th; new moon on the 15th; first quarter on the 23rd; and our second full moon on the 30th.

MERCURY: On the 20th of March Mercury reaches its greatest elongation west of the sun, but it is not especially favorable since it is some 15° south of the ecliptic. It may be seen for several days around this time in the east before sunrise. In April Mercury is too close to the sun to be of any interest.

VENUS: Venus is dominant in the southwestern sky during March, shining on the 5th at its greatest brilliancy of this eastern elongation, –4.3. By April it has moved closer to the sun, and reaches inferior conjunction on April 10th. It is about one minute of arc in diameter around this time, and displaying a graceful and delicate crescent in low power. It is interesting to see how near to inferior conjunction the planet can be observed. Some observers have followed it until the day before conjunction, then picking it up again a day or so later.

MARS: Mars is still in Gemini, but not the object it was a month or two ago. It begins March at 0.3, but fades to 1.3 by the end of April. Its angular size also



Planets are indicated by standard symbols (see key). White circles for first month; black circles for second month. Moon plotted for exact time of phase (new moon omitted). Mercury and Venus are shown for first, middle and end of months; Mars for middle of month; other planets for mean positions during the two-month period. Sun is shown for first of each month.

KEY TO PLANET SYMBOLS

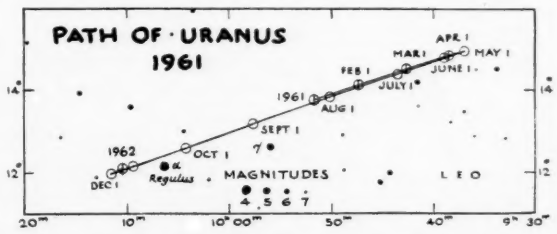
Mercury	☿	Saturn	♄	First Q. Moon	☽
Venus	♀	Uranus	♅	Full Moon	○
Mars	♂	Neptune	♆	Last Q. Moon	☾
Jupiter	♃	Pluto	P	Sun	s

shrinks from 9 seconds of arc to 6 seconds, and it is no longer of interest in a small telescope.

JUPITER: Jupiter moves from Sagittarius into Capricornus in March, but is still too low in the morning sky to be of observational interest until April. The times of phenomena of Jupiter's satellites and positions of the satellites are being resumed for April in the observing section of this issue. Its equatorial diameter grows from 34 seconds of arc on March 1st to nearly 40 seconds at the end of April, when its brightness will be nearly −2.0. Why not start observing it now and follow this fascinating and everchanging giant through an entire apparition—you will be surprised at the detail you will begin to see after a few weeks, and you should be able to identify its moons by their size, brightness and night-to-night positions. Although the planet will be low in this apparition, it will be higher than its 1960 position in Sagittarius.

SATURN: Saturn is also in Capricornus and just west of Jupiter during March and April. Its magnitude is about 0.8 and it presents a disk of some 30 seconds of arc.

URANUS: In March and April Uranus is high above in Leo in the early evening, making it an interesting object in binoculars and small telescopes. While it will not show a disk of any considerable size, spotting and following it among the stars is an enjoyable and instructive pastime.

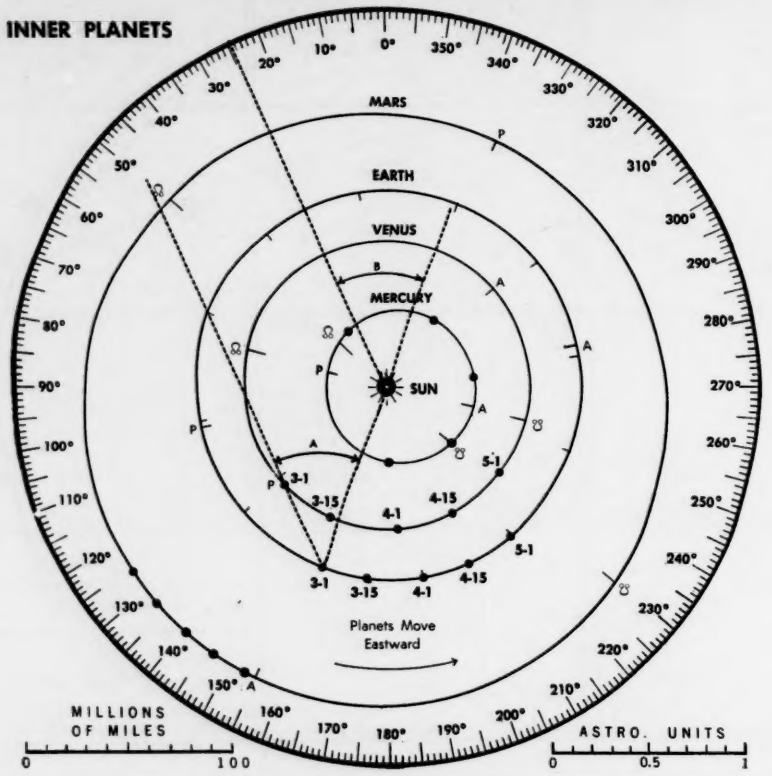


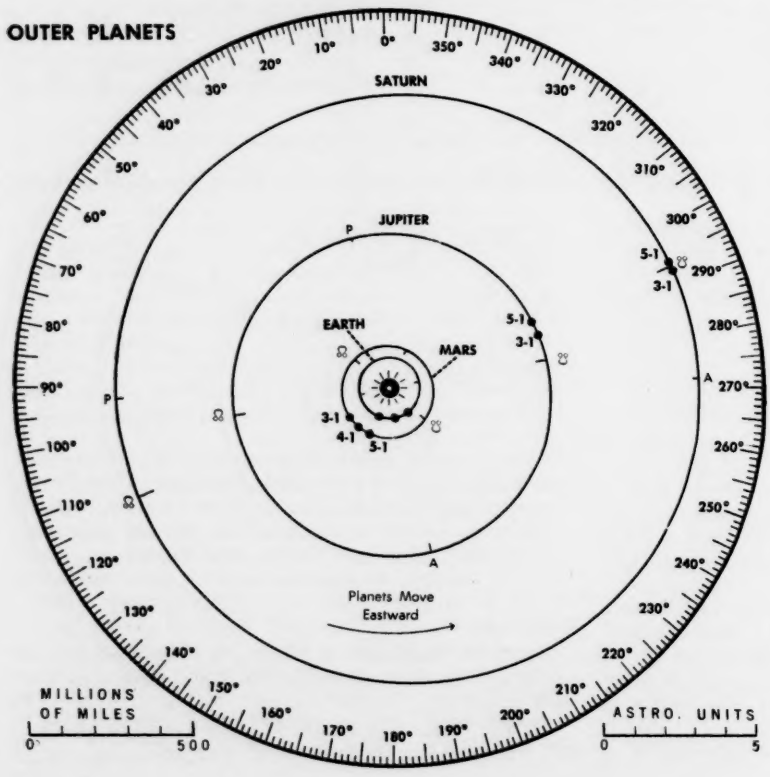
We have included a chart of its positions during the year, which was taken from the 1961 *Handbook* of the Royal Astronomical Society of Canada. Opposition was reached in February, and the planet will be moving westward (retrograding) among the stars until the end of April, when it resumes its eastward motion once more. It should be an object of about 5.9 magnitude during this period.

NEPTUNE: Neptune is in Libra, and reaches opposition at the end of April, at which time it will have a magnitude of 7.7.

PLUTO: Pluto is in Leo at RA 10h 54m, Dec. +21° 11′. Fifteenth magnitude, so don't wait up for it.

Heliocentric Planet Charts for March-April





Presented here are two new charts intended to show the heliocentric and geocentric movements and positions of the naked-eye planets. The upper indicates the orbits of the "terrestrial" planets—Mercury, Venus, earth and Mars—and the lower chart shows the orbits of Jupiter and Saturn, with those of Mars and earth for reference. The orbital positions of the inner planets are shown for the 1st and 15th of each month, from March 1st through May 1st, 1961. The positions of Jupiter and Saturn are shown only for March 1st and May 1st, as their motions are relatively slow. The positions of earth and Mars on April 1st have been added. Orbits are to scale.

Scales of distance in astronomical units (mean distance from earth to sun: 92,900,000 miles) and millions of miles are included for each chart, and can be used to measure approximate distances between any pair of planets, or planets and the sun. The nodes are indicated so that one may determine upon which side of the ecliptic, north or south, a planet will be found. Moving eastward, a planet, having crossed the ascending node (☊), will be *north* of the ecliptic, until it reaches the descending node (☋), when it crosses to the *south* until it passes the ascending node again. Positions of perihelion (P) and aphelion (A)—closest and farthest distance from the sun—are indicated by the appropriate letter and a long tick.

Progress of the planetary rhythms can be followed with considerable exactitude from month to month. Their configurations — conjunctions, oppositions, elongations, passages of perihelia, for example — should be easily noted. The interested reader will discover much other useful information that can be gleaned from study of this regular new feature.

Heliocentric and Geocentric Longitudes

The heliocentric longitude (i.e., as seen from *sun*) of a planet at any time can be read from the charts by drawing a straight line from the center of the sun through the planet and intersecting the outer scale of longitude at the required point. Dates between those indicated for any planet can be interpolated, or estimated.

The geocentric longitude (as seen from *earth*) will be found by drawing a straight line from the earth to

the planet which will be, in the case of our example for Venus on March 1st, as shown by the dotted line on the upper chart. Another line from the earth through the center of the sun will indicate on the outer scale the sun's geocentric longitude—the position at which we see Venus from earth. This line will form the angle A with the earth at the vertex. A third line drawn from the sun parallel to the first line (earth to Venus), with angle B equal to angle A, will intersect the outer longitude scale at the required geocentric longitude. Care should be taken to see that the orbital positions of both the earth and the planet are correct for the date selected.

In the case cited, Venus is in heliocentric longitude 134½°; the earth at 160°. The geocentric longitude of Venus becomes 24½°, while that of the sun is 340°. Checking the distance from earth to Venus on the proper scales we find it to be about 44,000,000 miles, or 0.47 astronomical units (0.47 x 92,900,000 miles).

SKY WATCHER'S DIARY

MARCH

Date	Hour (EST)	Event
1	9	Regulus 1° of moon.
2	9	Full moon
5	12	Venus greatest brilliancy
6	00	Mercury stationary
7	00	Neptune 3° S. of moon
9	22	Last quarter
12	15	Saturn 3° S. of moon
12	19	Jupiter 3° S. of moon
14	13	Moon at perigee
14	15	Mercury 0°.9 S. of moon
16	14	New moon
16	14	Vesta in conjunction with sun
18	14	Venus 12° N. of moon
19	13	Venus stationary
20	15	Mercury greatest elong. W. (28°)
20	16	Vernal equinox
21	23	Aldebaran 0°.2 S. of moon
23	22	First quarter
24	8	Ceres in conjunction with sun
24	13	Mars 7° N. of moon
26	10	Moon at apogee
28	2	Uranus 2° N. of moon
28	16	Regulus 1° N. of moon

APRIL

Date	Hour (EST)	Event
1	01	Full moon
3	05	Neptune 3° S. of moon
8	05	Last quarter
9	01	Saturn 3° S. of moon
9	09	Jupiter 3° S. of moon
10	19	Venus in inferior conjunction
11	03	Moon at perigee
13	16	Mercury 0°.3 N. of moon
15	01	New moon
17	20	Mercury 9° S. of Venus
18	08	Aldebaran 0°.4 S. of moon
22	00	Mars 5° N. of moon
22	17	First quarter
22	22	Mars 5° S. of Pollux
23	05	Moon at apogee
24	09	Uranus 2° N. of moon
25	00	Regulus 1° N. of moon
29	08	Uranus stationary
29	12	Venus stationary
30	....	(Daylight saving time begins)
30	08	Neptune at opposition
30	12	Neptune 3° S. of moon
30	14	Full moon

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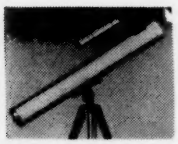

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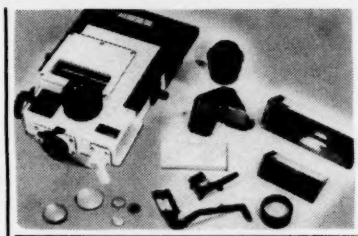

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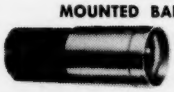

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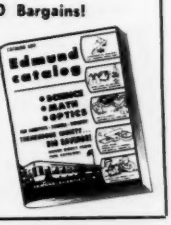

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LUNAR OCCULTATION PREDICTIONS — March-April 1961

Station & Location Long. West	Lat. North	Date (1961)	Designation and Catalog Number	Mag.	Phen.	Age of Moon	Time (EST) h	m	Correction Long.	Lat.	Position Angle
A (Massachusetts)											
72°.5	42°.5	Mar. 8	Gamma Librae 2223	4.0	D	21	00	46.6	−0.2	−0.9	153°
					R	5	13	8.7	−1.8	+2.0	248°
		Mar. 21	Theta[1] Tauri 669	4.0	D	5	20	18.7	−0.8	−1.8	104°
			Theta [2] Tauri 671	3.6	D	5	20	28.4	−0.5	−3.0	129°
			264 B Tauri 677	4.8	D	5	21	25.3	−0.6	−0.4	60°
B (Montreal)											
73°.6	45°.5	Mar. 8	Gamma Librae 2223	4.0	D	21	00	44.6	−0.3	−0.3	144°
					R		01	42.3	−1.5	+1.6	256°
		Mar. 21	Theta[1] Tauri 669	4.0	D	5	20	12.7	−0.8	−1.5	95°
			Theta[2] Tauri 671	3.6	D	5	20	19.6	−0.7	−2.5	118°
			264 B Tauri 677	4.8	D	5	21	23.7	−0.7	−0.2	51°
C (Wash., D. C.)											
77°.1	38°.9	Mar. 21	Theta Tauri 669	4.0	D	5	20	22.7	−0.8	−2.5	120°
			264 Tauri 677	4.8	D	5	21	24.7	−0.6	−0.8	75°
D (Toronto)											
79°.4	43°.7	Mar. 8	Gamma Librae 2223	4.0	R	21	12	09.5	−1.6	+2.5	241°
		Mar. 21	Theta[1] Tauri 669	4.0	D	5	20	10.3	−1.0	−1.8	104°
			Theta[2] Tauri 671	3.6	D	5	20	20.5	−0.8	−3.1	128°
			264 B Tauri 677	4.8	D	5	21	20.1	−0.8	−0.4	61°
F (Illinois)											
91°.0	40°.0	Mar. 21	Theta[1] Tauri 669	4.0	D	5	20	03.5	−1.6	−2.7	121°
			264 B Tauri 677	4.8	D	5	21	11.6	−1.1	−0.8	79°
		Apr. 8	43 Sagittarii 2814	5.0	R	23	03	43.2	−0.4	−0.6	323°
		Mar. 21	264 B Tauri 677	4.8	D	5	21	15.6	−1.3	−2.1	114°
G (Texas)											
98°.0	31°.0	Mar. 22	Aldebaran 692	1.1	D	5	00	10.0	−0.3	−0.0	58°
		Apr. 8	43 Sagittarii 2814	5.0	R	23	03	38.8	−0.7	+0.4	288°
H (Denver)											
105°.0	39°.7	Mar. 9	24 Scorpii 2399	5.0	R	22	17	14.4	−2.1	+0.1	271°
		Mar. 21	264 B Tauri 677	4.8	D	5	20	52.2	−1.7	−0.8	85°
		Mar. 22	Aldebaran 692	1.1	D	5	00	10.1	−0.8	+1.1	31°
					R	5	00	43.2	+0.6	−3.2	323°
I (N. Mex.-Ariz.)											
109°.0	34°.0	Mar. 9	24 Scorpii 2399	5.0	R	22	07	02.5	−2.6	+0.8	255°
		Mar. 21	264 B Tauri 677	5.0	D	5	20	51.2	−2.0	−1.6	105°
		Mar. 22	Aldebaran 692	1.1	D	5	00	05.0	−0.6	−0.1	59°
					R	5	00	58.4	+0.3	−1.8	296°
J (Edmonton, Alta.)											
113°.1	53°.5	Mar. 9	24 Scorpii 2399	5.0	R	22	07	02.5	−1.3	+0.2	289°
K (California)											
120°.0	36°.0	Mar. 9	264 B Tauri 677	5.0	R	22	06	38.0	−2.3	+1.7	246°
		Mar. 21	Aldebaran 692	1.1	D	22	23	56.0	−1.0	−0.1	61°
		Mar. 22		1.1	R	22	00	55.7	−0.1	−1.9	293°
		Apr. 4	Gamma Librae 2223	4.0	D	19	08	01.4	−1.8	−0.6	81°
L (Oregon)											
121°.0	42°.5	Mar. 9	24 Scorpii 2399	5.0	R	22	06	44.4	−1.8	+1.0	263°
		Mar. 21	Aldebaran 692	1.1	D	5	23	57.1	−1.2	+1.0	36°
		Mar. 22		1.1	R	22	00	39.8	0.0	−3.2	316°
		Apr. 4	Gamma Librae 2223	4.0	D	19	07	56.6	−1.7	−0.3	67°
M (Vancouver, B.C.)											
123°.1	49°.5	Mar. 9	24 Scorpii 2399	5.0	D	22	06	47.4	−1.3	+0.8	275°
		Apr. 4	Gamma Librae 2223	4.0	D	19	07	51.7	−1.6	0.0	53°

HOW TO USE THESE OCCULTATION PREDICTIONS

Predictions are made by H. M. Nautical Almanac Office for 12 stations in the United States and Canada. Some of these stations actually lie within certain large cities, but others are merely selected for geographical location and do not coincide with specific cities. Unless you live within a few miles of the points designated by longitude and latitude coordinates of one of these standard stations, corrections must be made to the times given in the above lists.

First, the longitude and latitude of the nearest standard station must be subtracted from your own longitude and latitude. If you are north of the standard-station latitude or north of the standard-station longitude, the sum will carry a minus sign. The difference in longitude is then multiplied by the longitude correction figure given in the tables for your standard station; likewise for the latitude correction. These two quantities are then added, being careful throughout to take into account the plus and minus signs. The sum of these two numbers will be your corrected factor for that occultation, and is subtracted or added, as the signs demand, from the listed time of occultation. These times are only a guide, however, and you should be prepared to begin observations a few minutes in advance of the predicted time.

Occulted stars are designated in most cases by constellation and appropriate Greek letter designation or Flamsteed number. In some cases the *Bonner Durchmusterung* catalog number (e.g., 57° 485) is used for fainter stars. Only stars brighter than 5.0 are published in this selected list. Complete predictions of all observable occultations are published in advance for each year in the December issue of SKY AND TELESCOPE magazine.

The column under "Phenomenon" shows whether the occultation is a disappearance (D), a reappearance (R), or a grazing occultation (G), which may or may not occur for a particular station. Age of the moon is given in days from new moon, and the position angle on the limb of the moon is given in degrees. Position angle is measured eastward from north; orientation can be determined by letting the moon drift through the field of view to establish the east-west axis. Be certain to allow for inversion by the telescope: in a normal situation, looking generally southward from the zenith, north (0°) will be toward the bottom of the field; south (180°) at the top; east (90°) at the right; and west (270°) at the left.

Observations should be sent, as soon after the end of the year as possible, to H. M. Nautical Almanac Office, Royal Greenwich Observatory, Herstmonceux Castle, Hailsham, Sussex, England.

BOOK REVIEW

AEROSPACE DICTIONARY

(Frank Gaynor. 260 pp. New York: Philosophical Library, Inc., 1960. $6.00.)

By Robert E. Cox

Terminology in the field of space exploration and travel has not only grown in proportion with the payloads lifted into orbit; space technicians have actually developed a language of their own that is nothing but a tower of Babel to the uninitiated. To assist the amateur astronomer and layman to better understand the jargon, Frank Gaynor, author of the Philosophical Library's *Concise Dictionary of Science*, has prepared this special volume devoted exclusively to space terms and the astronomical definitions associated with them.

The *Aerospace Dictionary* covers the field of rockets and missiles with a good cross-index of abbreviations and code names. For instance, around aircraft and jet personnel one might hear the term Gam 72 missile, and a check in this dictionary shows it to be the Quail, an air-to-surface decoy missile.

The book seems to be free of serious errors in its facts, indicating that a careful check was made before publication. However, one mistake will come to the attention of all readers, as it involves the listing of the Vanguard rocket series. On page 249, under Vanguard II, the second and third lines are transposed, but such an obvious slip should be readily evident to any casual reader.

A special introduction by Dr. Wernher Von Braun explains in simple yet concise language the reasons why man is trying and must go into space. It is a most interesting and illuminating discussion for the layman who might not yet understand the spaceman's deeper motives.

This book will have a limited appeal to the amateur astronomer due to its cost (in relation to its soon obsolescent contents) and only occasional use, but for a club or space-travel enthusiast it should be a valuable volume for members to refer to after a lecture on space technology.

PUBLICATIONS OF THE CELESTIAL MAP PUBLISHING CO.

When Sky Map Publications, Inc., purchased the rights to the old Monthly Evening Sky Map we also obtained an inventory of astronomical items and publications published by the former owners, the Celestial Map Publishing Co. These items have enjoyed a steady sale for many years and are brought to your attention at this time.

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- **BACK ISSUES OF MONTHLY EVENING SKY MAP.** We have several dozen sets of the old **Monthly Evening Sky Map** for the years 1940-1960. Many new readers have expressed an interest in having copies for their files. Unfortunately, we have no copies available for sale from the years 1909-1939.

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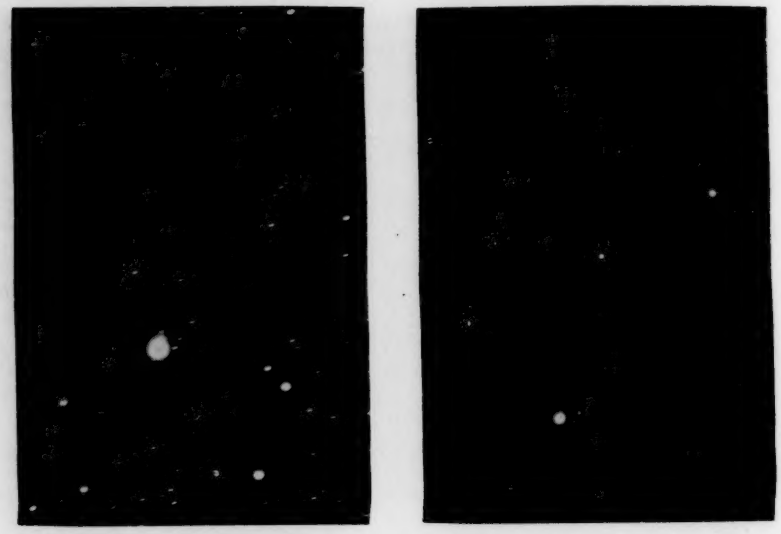
COMET REPORT

COMETS CANDY AND ENCKE

THE LAST COMET to be discovered in 1960 was found by M. P. Candy, director of British Astronomical Association's comet section. Mr. Candy was testing an eyepiece on a 5-inch comet-seeker on the night of December 26th when he sighted an 8th magnitude object moving rapidly southeastward in the constellation of Cepheus. Closest approach to the sun of this object was reached on February 9th—98½ million miles. However, its motion carried it away from the earth as it neared the sun, so it slowly faded in brightness.

Its appearance could be described as very ordinary, as faint comets go (see sketch). The coma was roughly 5′ of arc in diameter, centrally condensed and spherical in shape with an ill-defined edge. Visual observations in January failed to reveal any tail, although it showed a tail of about 20′ of arc in photo. By March this object will have moved into the evening twilight, a difficult object at nearly 10th magnitude. The ephemeris, as continued from the January-February issue is: Jan. 26, 23^h 23.2^m, + 19° 40′; Feb. 5, 23^h 30.8^m, + 12° 52′; Feb. 15, 23^h 36.4^m, + 8° 07′; Feb. 25, 2^h 41.0^m, + 4° 30′.

Comet Candy moved through a rich region of the Milky Way and once again, as has been noted for comets in the past, stars in its direct path seemed to be unobscured by its passage over them. This shows very definitely the extreme thinness of the comet's body. Thus it is that, while comets are the largest bodies in the solar system, in space occupied, their masses are very small fractions of the earth's total mass. Someone has said that comets are the nearest thing to nothing that something can be and still be something. It is probably true that the converse also holds: that a comet is the nearest thing to something that nothing can be and still be nothing.



These photos (Comet Candy, left, enlarged 5.3x, and Comet Encke, right, enlarged 3x) were both made on Jan. 17-18, 1961, by Alan McClure of the Los Angeles Astronomical Society using 15-minute exposures on blue-sensitive plates with a 7-inch aperture f/7 Fecker triplet lens. Candy's tail measured about one-third a degree, while Encke's stretched from more than 2°. McClure remarked that the latter's tail was quite faint; also that tail showed decided break scarcely visible in this reproduction. Candy was much brighter visually than was Encke.

In contrast to the appearance of Comet Candy, Comet Encke, whose long history of reappearances was traced in the last issue, looked very different. This object was visible in small telescopes for several weeks in January, but will be unfavorably placed for northern hemisphere observers in March and April, as can be seen from the ephemeris published in the last issue. Many visual observations were made by members of the ALPO—one of which is shown in the accompanying sketch. An extraordinary feature of the comet was noted in both visual and photographic observations on Jan. 7th. Dr. Elizabeth Roemer of the U. S. Naval Observatory's Flagstaff station reported that photographs taken by her at Flagstaff showed the coma to be *entirely* in front of the central condensation. This can be seen in the sketch, the coma being sickle-shaped with a short appendage. The seemingly peculiar orientation of this appendage is due to perspective. At the time the sketch was made the tail was between the earth and the comet; the view was through the tail into the heart of the comet. At this time the comet was almost equidistant from the sun and the earth—about 70 million miles. The drawings of the two comets are on almost the same scale, the angular diameter of 5′ of arc for Comet Candy corresponding to a diameter of nearly 50,000 miles; for Comet Encke, 65,000 miles.

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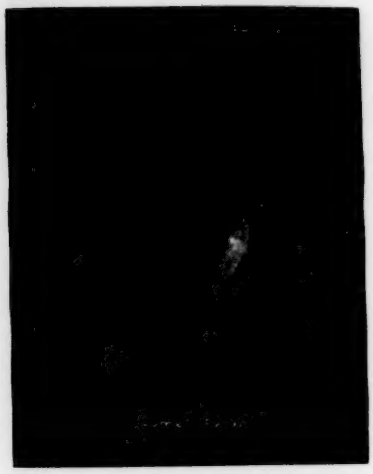
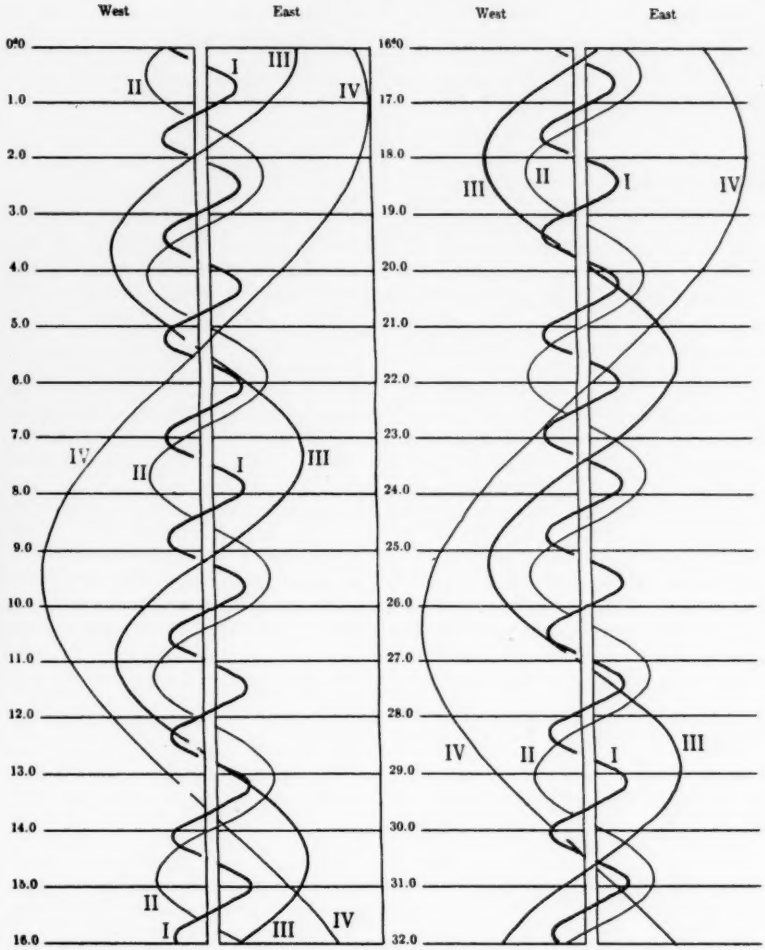
DAVID D. MEISEL



Drawings of Comets Encke and Candy made by David D. Meisel, A.L.P.O. Comets Recorder on Jan. 7, 1961, 1h 30m to 2h 00m U.T., using an 8-inch reflector at 80x. The magnitude of Comet Encke was estimated to be 8.5; Comet Candy about 8.2. Seeing conditions were good with no moonlight and the transparency was clear enough to see 6.0 stars at the zenith. Since the comets were roughly the same distance from the earth at this time, their respective diameters (about 50,000 miles) are comparable, but their distances from the sun were not the same. The sketches are orientated with north at the top.

JUPITER'S SATELLITES FOR APRIL

(Too close to sun in March)



PHENOMENA OF JUPITER'S SATELLITES FOR APRIL

Date	Time (EST)	Satellite	Phen.
5	4:21	IV	Te
6	4:18	I	SI
10	4:00	II	Te
12	3:59	III	ED
15	4:12	I	Te
17	3:48	II	TI
	4:00	II	Se
22	3:51	I	TI
23	3:16	III	TI
	3:28	I	OR
24	3:47	II	SI
26	3:29	II	OR

(Times EST) E—eclipse (satellite passes into shadow of planet); O—occultation (satellite passes behind planet); T—transit (satellite or satellite shadow passes across disk of planet); S—shadow (shadow of satellite cast on disk by sun); D—disappearance; R—reappearance; I—ingress (entrance upon disk); e—egress (exit from disk). Satellite designations: I—Io; II—Europa; III—Ganymede; IV—Callisto.

EXPLANATION OF SATELLITE DIAGRAM

Effective with the unification of the British and American Nautical Almanacs the monthly configurations of Jupiter's bright satellites are now presented in a new and more useful type of diagram.

The central vertical band in the diagram represents the equatorial diameter of the disk of Jupiter. The relative positions of the satellites at any time with respect to the disk of Jupiter are given by the curves. In cases where a satellite is immersed in the shadow of Jupiter or occulted by its disk, the curve is interrupted.

The horizontal lines show the positions of the satellites at Oh Universal Time (Greenwich Mean Time) for each day of the month. For example, the horizontal line for the 15th of this month would show the positions of the satellites at 7:00 p.m. on the 14th of the month for an observer in the Eastern time zone.

(Diagrams taken from 1960 *American Ephemeris and Nautical Almanac.*)

YOUR TELESCOPE AND MINE

A Look At Refractors

By Thomas R. Cave

It has been just about 35 years since the hobby of amateur telescope making became established in this country, and during this time the 6-inch reflector has reigned as the most popular telescope for the amateur. Nevertheless, with the completion of the amateur's first mirror often comes the urge to delve into the world of wider apertures and more sophisticated systems—10- and 12-inch mirrors, optical flats and prisms, and the compound telescopes such as Cassegrains and Gregorians, which are more demanding than the 4- to 8-inch mirrors. The compound telescopes, for example, require a primary and a secondary mirror, the latter being figured to an ellipsoidal curve in the case of a Gregorian and a hyperboloid in the case of a Cassegrain. The compound telescopes are often disappointing in performance, although this is not inherent in the system itself, but only in the fabrication, mounting, and collimation (or lining up) of the components of the optical train. In spite of this, many amateurs quickly move on into this "twilight zone" of amateur endeavor, and many splendid instruments have resulted.

Because of this, it is a bit surprising that so few amateurs—even the more advanced ATM's—attempt to make the standard type of two-element, airspaced refractor objective. As we will point out in a few moments, the surfaces of an objective lens are usually figured to a spherical curve, a much easier figure to work with than a paraboloid as required in a Newtonian reflecting telescope. However, other requirements enter into the working of a refractor objective and, although most readers are still contemplating or immediately involved in their first mirrors and are not yet ripe for lens work, a brief description of the process may be of interest. It will certainly show the amateur why commercially made objective lenses of fair to excellent quality carry the much higher "inch-for-inch" price tag that they do, as compared to mirrors of equal size and quality.

In the first place, basic supplies and equipment are more expensive and demanding than those for making a mirror. An optically flat mirror at least as large as the proposed objective must be obtained, plus a dial micrometer indicator measuring to 1/10,000th of an inch. Almost a necessity is an optical spherometer. which measures the various radii of the spherical surfaces after the figuring process is begun; although spherical surfaces are easier to generate then parabolas and other figures, each must be figured to an *exact* radius of curvature. A spherometer enable an ATM to accomplish this mechanically as he proceeds with his

work. Also, a convenience, although not a requirement, is a good-sized (9-inch) engine lathe for working the glass.

An important consideration in making a refractor objective is to make a lens large enough for ease in working. A 6-inch objective is probably easier for an ATM to work by hand than a 4-inch, and will afford a far more powerful telescope than a smaller aperture. It is also important to obtain the finest possible blanks of crown and flint optical glass. In recent years the fine glass of first quality has become far less expensive than was once the case. Very good molded and precision-annealed blanks are now obtainable from domestic sources, although the

The observatory and home-fabricated refractor of Bob Wright, Silver Springs, Md., whose article appears on page 13 of this issue. Sliding roof, rugged mount makes for observing pleasure and efficiency.

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finest refractor blanks still are made in England by Chance of Birmingham and in Germany by the Schott-Jena works. Foreign-manufactured optical glass is considerably more expensive than American and probably about as good an amateur refractor may be made of American optical glass.

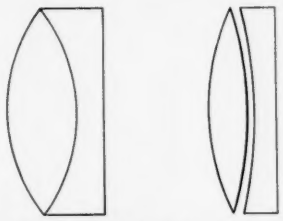
One of the most convenient amateur sources of American refractor blanks is the Hayward Scientific Optical Glass Corp. of Whittier, Calif. An excellent first-quality set of matched crown and flint 6-inch-diameter blanks can be bought for something less than $100.00. These blanks are very accurately molded and little or no edging should be required.

The four radii should be ground with very careful attention, both elements being parallel at the edge so that the dial indicator is within one or two ten-thousandths of the same reading throughout the entire circumference of each blank. The center thickness must also be held within a few thousandths of an inch.

Polishing is performed exactly as with a spherical telescope mirror—using a total one-third diameter stroke. Since all four polished surfaces of the objective are spherical, the final figuring after polishing is not nearly as difficult as producing a near-perfect parabola. The *four* separate spherical surfaces are each about one-quarter as demanding in departure from a critical figure as the *one* surface of a telescope mirror. Small errors in the spherical figure of the convex surfaces can be compensated by local correction in the concave surface, so that one error can be cancelled out by another.

When all four surfaces of the two elements have been carefully and fully polished, they can be set up in a temporary cell ring, or, if desired, in the final cell and tested against the silvered or aluminized optical flat by using the knife-edge test, exactly as in the testing of a telescope mirror. Since the light passes through the objective lens *twice* before being cut off by the knife edge, the resultant zonal errors visible when the pinhole image is partially cut off by the knife edge are doubled—seemingly twice as bad as they actually exist on the surfaces of the lens being tested.

Thin shims of equal thickness, spaced 120 degrees apart, will give the air-space required in the objective. Beginning with the objective elements spaced only about ten-thousandths of an inch apart, several sets of shims should be tried, each set thicker until the spacing of the elements indicates a minimum of visible color aberration. The final color visible after the proper spacing has been achieved will be a faint blue or light purple tinge.



(Left) Cemented achromatic objective and (right) airspaced objective. Cemented achromats are satisfactory for finders and small telescopes, are less expensive since all curved surfaces have equal radii, minimizing cost and assembly. All larger objectives are airspaced to allow maximum correction of aberrations.

Today, seamless aluminum extruded tubing of heavy wall thickness is available in sizes to at least eight inches in diameter. This tubing is not expensive and is ideal for a 6-inch refractor. The completed telescope assembly should be mounted permanently on a high concrete pier or heavy oil pipe casing. A solid equatorial head strong enough to carry an 8-inch reflector will easily handle a 6-inch f/15 refractor. If the advanced ATM will purchase the best raw glass, carefully make the objective lens, tube fittings, and mounting, he will find that he can produce an excellent 6-inch refractor for a very small fraction of the cost of a new refractor of equal size if purchased complete from a well known maker.

The high cost of a large new refractor usually limits the amateur astronomer to about a 4-inch refractor. If the amateur does not wish to do the optical work, but is able to mount an objective lens, he will do well to purchase a 3- to 6-inch objective of good to excellent quality and mount it entirely himself. Such objectives can be purchased today for very reasonable prices (both new and used). A fine refractor will nearly always give a good account of itself and will usually give steadier star images on nights of poor "seeing" than a reflector or equal aperture. While a first-class Newtonian reflector will equal and sometimes excel a refractor for lunar, planetary, and deep sky observing under moderate to good "seeing" conditions, a fine refractor is certainly the best in producing perfect star images and in the resolution of close double stars—the latter being an area of astronomical observation in which the refractor is totally unequaled. A fine old Alvan Clark refractor is among the most cherished of this writer's telescopic equipment.

[Questions on telescopes should be directed to Mr. Cave in care of this magazine.]

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SELECTING EYEPIECES AND ACCESSORIES

By Robert E. Cox

The most important accessory of any telescope, refractor or reflector, is the eyepieces that are used to magnify the prime focus image. The actual construction of lenses for eyepieces is not beyond the amateur, especially one with the experience of objective making. However, it is the mounting of the small lenses of eyepieces that often presents the major stumbling block, the fine threads and sensitive and accurate spacing necessitating a precision thread-cutting lathe. It is by far the better expedient to purchase the eyepieces, especially if one expects to have an instrument operating in a reasonable working time.

In purchasing eyepieces—as in any optical equipment—one cannot expect any more than he pays for, a low-cost one giving average and passable performance, an expensive one superb definition and resolution. The standard simple eyepiece for the refractor is the Huygenian (Fig. 1a), and at focal ratios of f/15 or over this eyepiece gives good definition at low and medium powers. This is the type of ocular used on microscopes, where it is not necessary to have a reticle in the image plane. The focal plane is between the lenses, hence this assembly cannot be used as a simple magnifier.

Don't use regular Ramsden (Fig. 1b) eyepieces with a refractor! They are not designed to operate at the focal ratio of an objective lens, but instead are designed for shorter-focus reflecting systems of f/8 or lower, and introduce serious and detectable aberrations into the optical system.

At medium powers the Kellner eyepiece (Fig. 1c)—also known as the achromatized Ramsden — performs well with the refractor, as does the Ploessl or symmetrical eyepiece (Fig. 1d).

For high-power observation only the best eyepieces obtainable should be used if the observer expects to reach the full performance of the objective. For an average field of view, the orthoscopic eyepiece (Fig. 1e) is one of the best and, although the cost may well be two or three times that of a low-cost ocular, the serious observer will find the investment well worth while.

Since the war a number of eyepieces have been developed which use a combination of two achromatic components and a simple lens (or three achromats) to produce an eyepiece of exceptional definition and having a field of view almost twice that of the orthoscopic eyepiece. Perhaps the best known of these eyepieces is the 1¼" Erfle used on Moonwatch telescopes for satellite tracking. One of the various combinations of elements of this type of eyepiece is shown in Fig. 1f.

Guest at St. Louis Astronomical Society star party uses refractor equipped with zenith diagonal for comfortable viewing. High eye-relief of orthoscopic eyepieces is another must for successful viewing by inexperienced visitors.

There are three other telescope accessories that can assist the observer—the zenith prism, the Herschel wedge and a Barlow lens. The zenith prism is actually a necessity when using a refractor, for it bends the light path at right angles and enables the observer to view objects at or near the zenith without assuming awkward positions. A good ¼-wave or better front-surface aluminized mirror (the diagonal for a reflecting telescope) can perform the same operation (Fig. 2a).

If one wishes to view sunspots directly through his instrument a Herschel wedge (Fig. 2b) is an excellent accessory. Combined with a medium density filter located behind the eyepiece, this wedge can be used to view the sun at full aperture in perfect safety. A war surplus penta prism, with the silver removed from the reflecting surfaces (Fig. 2c), also makes an excellent light and heat reducing accessory.

The Barlow lens is an accessory that was popular in England and on the Continent long before it came into common use on a large scale in the United States. It is designed as either a simple or an achromatic negative element (Fig. 3), which increases the focal length of the primary element and enables the observer to obtain high powers with the application of only low- or medium-power eyepieces. It is necessary to place the eye extremely close to the rear opening of a high-power eyepiece (in fact, the observer's eyelashes often touch the metal surface), but the combination of low-power or medium-power eyepieces and a Barlow lens allows the observer to place his eye farther from the eyepiece, increasing his comfort and consequently the accuracy of his observing.

Good arguments can be precipitated over the relative merits of the simple and the achromatic Barlow lens, but it is generally conceded that for low Barlow amplifications (1½x to 2x), the simple lens works

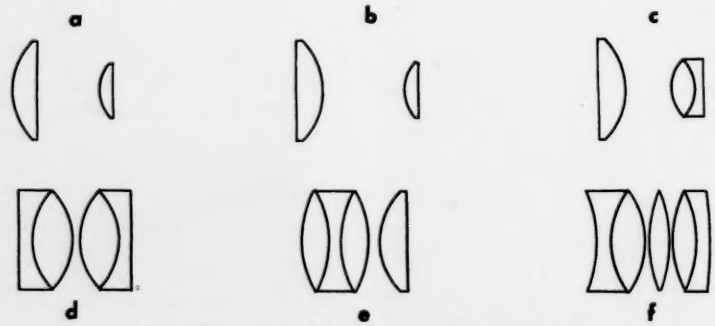

Fig. 1. Types of ocular combinations in use today.

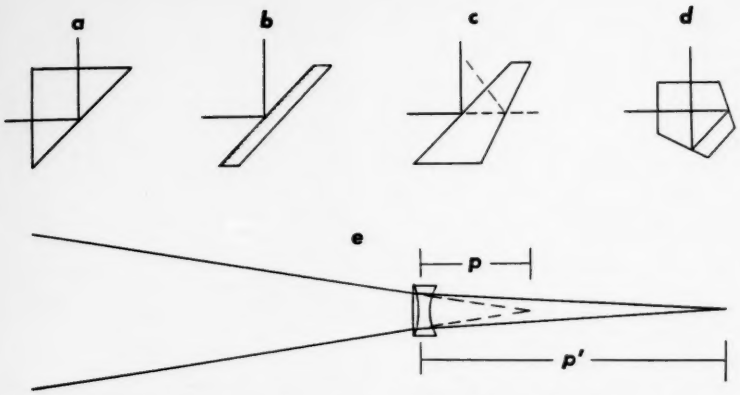

Fig. 2. Zenith viewing can be done with the right angle prism (a) or the front surface mirror (b) while for viewing the sun either a Herschel wedge (c) or an unsilvered penta prism (d) should be used. The back surface of the Herschel wedge is inclined at 10° to the unsilvered front surface thereby placing the image of the sun off this surface at an angle to the optical axis such that it cannot interefere with the direct view. The amplification of focal length of a primary focus by the Barlow lens (e) is in the ratio of P^1/P.

well for most observers. The most discriminating amateur, and those using amplifications of more than 2x, prefer the achromatic Barlow lens.

One thing must be remembered by amateurs, however, whether they use refractors or reflectors. The best performance of an instrument can only be realized with good quality eyepieces, and unless one is able to spend the money for such equipment, then the 1/10-wave or 1/20-wave accuracy of your primary optics can be completely wasted. Fortunately, there are today several sources of top-quality orthoscopic and Erfle oculars in the United States.

Members of the Buffalo Astronomical Association and staff of Cornell Aeronautical Laboratory combine efforts to build an observatory for the amateurs on grounds of the Radio Physics Laboratory at Newstead, N. Y. Labs constructed building, Buffalo amateurs the 15-foot dome being set on building by crane in this picture. Observatory, which also contains an office wing, should be completed this summer, and will house a 12-inch reflector and a 6-inch refractor.

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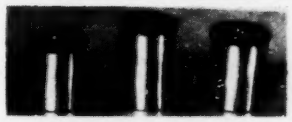

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The second but often-used instrument of Mr. Smith's Skyview Observatory in Eagle Pass, Tex. Mr. Smith reports on an observation, made with his 8" nearly 20 years ago, in the letter below.

AMATEUR'S FORUM

(Continued from page 3)

ing. The star was said to have been seen even after Herod had been told of it. Secondly, any phenomenon seen in the sky in those days of astrological interest would have been reported by hundreds, but alas, no report was ever made of it.

Dr. Josef R. Otoupalik
800½ Ninth St.
Greeley, Colo.

Gentlemen:

During the past year you have more than fulfilled the promise of your first issue—to make it, indeed, "the amateur's own magazine." I have derived particular enjoyment from "Through the Three-Inch" in that, since 1953, my main instrument has been a Unitron 3-inch refractor with both altazimuth and equatorial mounts and tripods. I own several instruments, but it is the 3-inch that I turn to 75% of the time. . . . When on its altazimuth mount, the entire instrument can be carried under one arm.

Willard E. Robinson
7018 N. Ashland Ave.
Chicago 26, Ill.

We want to thank Mr. Robinson and the many other readers who have written to express their interest in our magazine. We are happy that it has found a point of service to the amateur astronomer. As for the comment on small instruments, see "Through the Three-Inch" in this issue.

The Editors
REVIEW OF POPULAR ASTRONOMY

Dear Sirs:

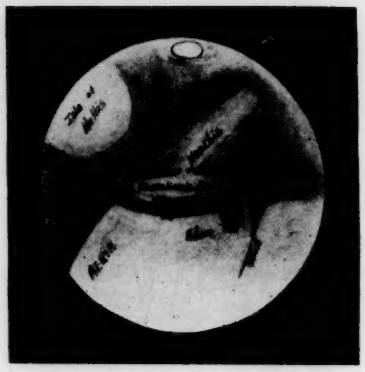
I would like to call your attention to an interesting and memorable observation which I made nearly 20 years ago in Lubbock, Tex. On the night of Oct. 1, 1941, I observed Mars with my excellent 8-inch reflector of 60" focal length, a photo of which is enclosed. (The telescope was purchased in 1936, has a heavy, steady mounting on a concrete pier and an excellent clock drive, I still use it frequently, although I now have a 16-inch telescope and an observatory.)

It was the hardest image of Mars that I had ever seen. The clarity and hardness of the image were due in part to heavy fog, which was of just the right consistency to cut the glare and make the contrast just right. When I had finished the sketch (see attached drawing), water was running down the inside of the tube, and in another few minutes the flat diagonal mirror had dewed over.

I have always remembered this view—I could still draw the image from memory. It was amazing!

J. Russell Smith
Skyview Observatory
Eagle Pass, Tex.

Mr. Smith, a school science coordinator and author of the book TEACHING A UNIT IN ASTRONOMY, GRADES 1-9, *makes an interesting point and one that is little known. A fog, or a smoke haze, will often reduce glare and enhance contrast of bright, extended images such as those of the planets. Beyond this, the fog or haze, which owes its existence to atmospheric stability, seems to contribute even further to this stability.*



Mars on Oct. 1, 1941, as drawn by the writer under "ideal (?)" seeing conditions. Features are barely exaggerated, he indicates.

Numerous reports have been made, by British planetary observers Denning and Williams, for example, of unbelievable observations of Jupiter and Mars under conditions of heavy fog in Liverpool and other English coastal areas. The smoke palls of autumn, when fall leaves are burned and settle in stable layers several hundred feet above, frequently afford excellent views of the planets. Just how much of this "low-transparency, high-seeing" condition is accounted for by the smoke and how much by the stable condition of the lower air which allows the smoke pall to form is open to question, of course. Nevertheless, observers shouldn't always be cowed by these conditions, as Mr. Smith's excellent sketch of Mars attests.

Incidentally, Mr. Smith operates one of the country's better equipped amateur observatories. His equipment will be the subject of an article in the May-June issue of THE REVIEW OF POPULAR ASTRONOMY.

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Dear Sirs,

This letter is both a belated thank you note for your prompt attention to my last order and an order for another item. In my last order I was in a hurry for an item, and asked for a rush order. I was amazed at how soon even UNITRON processed my order. I have noticed that you take pride in your customer satisfaction, so I decided to compliment you also.

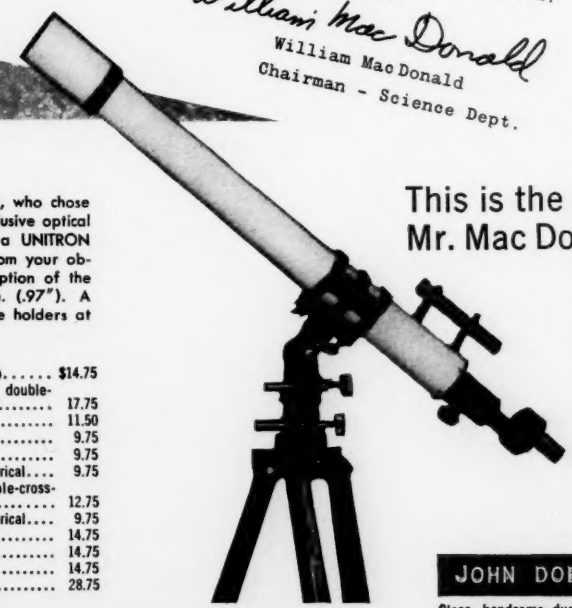
This will probably be one of your more unusual testimonials, because I do not even own a UNITRON. That's right. Our science club was saving up to buy a 2.4-inch UNITRON when a local resident offered to donate to the club a four-inch refractor which he had purchased from another manufacturer. Well, it wasn't UNITRON, but our small club could hardly afford to look this gift horse in the mouth. However, the telescope had no accessories. Our telescope was valued at about $600 so we wanted nothing but the best to fully equip it. This is where UNITRON came in.

We now have a UNITRON equipped telescope, which is the next best thing to a UNITRON telescope. The additional eyepieces that we ordered made a world of difference in viewing. They were far superior to those that came with our telescope. Now, we are ready to purchase a sun projecting screen. Again we are coming to you. We have learned that when you buy UNITRON, you buy peace of mind. Please mail us a projection attachment for our four-inch refractor, and bill me for the amount. Thank you very much.

Sincerely,

William Mac Donald

William Mac Donald
Chairman - Science Dept.



This is the UNITRON Mr. Mac Donald didn't buy...

"We wanted nothing but the best," says Mr. MacDonald, who chose from this superb array of coated UNITRON eyepieces. Exclusive optical design and painstaking care in manufacture explain why a UNITRON eyepiece will allow you to obtain maximum performance from your objective or mirror. The following eyepieces, with the exception of the 40 mm. and 60 mm., have outside diameters of 24.5 mm. (.97"). A plastic adapter bushing is available for 1¼" O.D. eyepiece holders at an additional cost of 35¢.

40 mm. Monochro (1¼" O.D.)	$14.75
40 mm. — as above, with double-crossline	17.75
25 mm. Ramsden	11.50
18 mm. Kellner	9.75
12.5 mm. Kellner	9.75
9 mm. Achromatized Symmetrical	9.75
9 mm. — as above, with double-crossline	12.75
7 mm. Achromatized Symmetrical	9.75
6 mm. Orthoscopic	14.75
5 mm. Orthoscopic	14.75
4 mm. Orthoscopic	14.75
60 mm. Kellner	28.75

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This new addition to the Dynascope line has won immediate recognition from schools, colleges, and professionals, as an outstanding achievement in a 6-inch telescope. Although it was only recently introduced, our files are already filled with complimentary letters from excited amateurs and professionals all over the country. Each one is truly amazed at the superior optical performance of this new RV-6 6-inch Dynascope! Here is large aperture in a quality instrument at a price that compares with many 4-inch telescopes. *And this low cost includes such exclusive extra features as electric drive* (patented), *setting circles, and rotating rings!* There are no "extras" to run up your cost!

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ENJOY IT NOW — take up to 24 months to pay under our Easy Terms plan!

Just a small down payment delivers this big 6-inch DYNASCOPE. Pay the balance at your convenience over 6, 12, 18, or even 24 months! Write for details, or order today by sending your check or money order with coupon below.

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1. **EXQUISITE OPTICAL SYSTEM INCLUDES F/8 6-INCH PARABOLIC PYREX MIRROR** accurate to better than ⅛ wave, zircon-quartz coated, and guaranteed to reach all theoretical limits of resolution and definition. Teamed with elliptical diagonal, mounted on 4-vane adjustable spider.
2. **NEW DYN-O-MATIC ELECTRIC DRIVE** with smooth self-acting clutch that engages and disengages automatically as you seek different objects. Will not interfere when manual operation is desired. Entire drive housed in trim aluminum case. Plugs into ordinary household socket.
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7. **ROTATING RINGS FOR MAXIMUM VERSATILITY AND VIEWING COMFORT.** Solid-cast, chrome finish, rings are generous 1" wide with felt lining. Newly designed construction, with over sized knurled adjusting knobs, affords maximum rigidity and allows for quick disassembly and portability, with or without tube.
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"I never dreamed such a brilliant, clear image could be had with a telescope costing under 200. It is one of these rare bargains that you find only once or twice in a lifetime."
B.S.—New Jersey

"A friend of mine has a 6-inch telescope without electric drive, for which he paid over $300. He agrees that my new DYNASCOPE not only outperforms it, but is a much better-looking and better-built instrument." **J.L.—New York**

"Congratulations on the excellence of your workmanship. The optics are truly amazing. I never expected such wonderful performance."
L.H.N.—Massachusetts

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far the better expedient to purchase the eyepieces, especially if one expects to have an instrument operating in a reasonable working time.

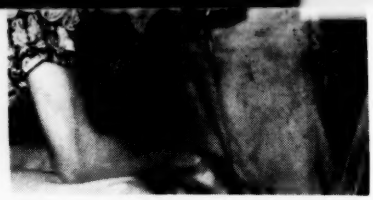
In purchasing eyepieces—as in any optical equipment—one cannot expect any more than he pays for, a low-cost one giving average and passable performance, an expensive one superb definition and resolution. The standard simple eyepiece for the refractor is the Huygenian (Fig. 1a), and at focal ratios of f/15 or over this eyepiece gives good definition at low and medium powers. This is the type of ocular used on microscopes, where it is not necessary to have a reticle in the image plane. The focal plane is between the lenses, hence this assembly cannot be used as a simple magnifier.

Don't use regular Ramsden (Fig. 1b) eyepieces with a refractor! They are not designed to operate at the focal ratio of an objective lens, but instead are designed for shorter-focus reflecting systems of f/8 or lower, and introduce serious and detectable aberrations into the optical system.

At medium powers the Kellner eyepiece (Fig. 1c)—also known as the achromatized Ramsden — performs well with the refractor, as does the Ploessl or symmetrical eyepiece (Fig. 1d).

For high-power observation only the best eyepieces obtainable should be used if the observer expects to reach the full performance of the objective. For an average field of view, the orthoscopic eyepiece (Fig. 1e) is one of the best and, although the cost may well be two or three times that of a low-cost ocular, the serious observer will find the investment well worth while.

Since the war a number of eyepieces have been developed which use a combination of two achromatic



Guest at St. Louis Astronomical Society star party uses refractor equipped with zenith diagonal for comfortable viewing. High eye-relief of orthoscopic eyepieces is another must for successful viewing by inexperienced visitors.

components and a simple lens (or three achromats) to produce an eyepiece of exceptional definition and having a field of view almost twice that of the orthoscopic eyepiece. Perhaps the best known of these eyepieces is the 1¼" Erfle used on Moonwatch telescopes for satellite tracking. One of the various combinations of elements of this type of eyepiece is shown in Fig. 1f.

There are three other telescope accessories that can assist the observer—the zenith prism, the Herschel wedge and a Barlow lens. The zenith prism is actually a necessity when using a refractor, for it bends the

reflecting surfaces (Fig. 2c), also makes an excellent light and heat reducing accessory.

The Barlow lens is an accessory that was popular in England and on the Continent long before it came into common use on a large scale in the United States. It is designed as either a simple or an achromatic negative element (Fig. 3), which increases the focal length of the primary element and enables the observer to obtain high powers with the application of only low- or medium-power eyepieces. It is necessary to place the eye extremely close to the rear opening of a high-power eyepiece (in fact, the observer's eyelashes often touch the metal surface), but the combination of low-power or medium-power eyepieces and a Barlow lens allows the observer to place his eye farther from the eyepiece, increasing his comfort and consequently the accuracy of his observing.

Good arguments can be precipitated over the relative merits of the simple and the achromatic Barlow lens, but it is generally conceded that for low Barlow amplifications (1½x to 2x), the simple lens works

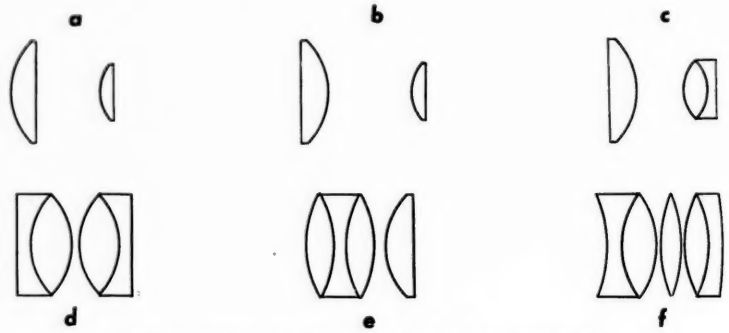


Fig. 1. Types of ocular combinations in use today.

XUM

Fig. 2. Zenith viewing can be done with the right angle prism (a) or the front surface mirror (b) while for viewing the sun either a Herschel wedge (c) or an unsilvered penta prism (d) should be used. The back surface of the Herschel wedge is inclined at 10° to the unsilvered front surface thereby placing the image of the sun off this surface at an angle to the optical axis such that it cannot interefere with the direct view. The amplification of focal length of a primary focus by the Barlow lens (e) is in the ratio of P'/P.

well for most observers. The most discriminating amateur, and those using amplifications of more than 2x, prefer the achromatic Barlow lens.

One thing must be remembered by amateurs, however, whether they use refractors or reflectors. The best performance of an instrument can only be realized with good quality eyepieces, and unless one is able to spend the money for such equipment, then the 1/10-wave or 1/20-wave accuracy of your primary optics can be completely wasted. Fortunately, there are today several sources of top-quality orthoscopic and Erfle oculars in the United States.

Members of the Buffalo Astronomical Association and staff of Cornell Aeronautical Laboratory combine efforts to build an observatory for the amateurs on grounds of the Radio Physics Laboratory at Newstead, N. Y. Labs constructed building, Buffalo amateurs the 15-foot dome being set on building by crane in this picture. Observatory, which also contains an office wing, should be completed this summer, and will house a 12-inch reflector and a 6-inch refractor.

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The second but often-used instrument of Mr. Smith's Skyview Observatory in Eagle Pass, Tex. Mr. Smith reports on an observation, made with his 8″ nearly 20 years ago, in the letter below.

AMATEUR'S FORUM

(Continued from page 3)

ing. The star was said to have been seen even after Herod had been told of it. Secondly, any phenomenon seen in the sky in those days of astrological interest would have been reported by hundreds, but alas, no report was ever made of it.

Dr. Josef R. Otoupalik
800½ Ninth St.
Greeley, Colo.

Gentlemen:

During the past year you have more than fulfilled the promise of your first issue—to make it, indeed, "the amateur's own magazine." I have derived particular enjoyment from "Through the Three-Inch" in that, since 1953, my main instrument has been a Unitron 3-inch refractor with both altazimuth and equatorial mounts and tripods. I own several instruments, but it is the 3-inch that I turn to 75% of the time. . . . When on its altazimuth mount, the entire instrument can be carried under one arm.

Willard E. Robinson
7018 N. Ashland Ave.
Chicago 26, Ill.

We want to thank Mr. Robinson and the many other readers who have written to express their interest in our magazine. We are happy that it has found a point of service to the amateur astronomer. As for the comment on small instruments, see "Through the Three-Inch" in this issue.

The Editors
REVIEW OF POPULAR ASTRONOMY

Dear Sirs:

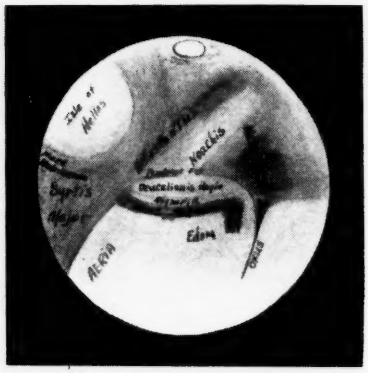
I would like to call your attention to an interesting and memorable observation which I made nearly 20 years ago in Lubbock, Tex. On the night of Oct. 1, 1941, I observed Mars with my excellent 8-inch reflector of 60″ focal length, a photo of which is enclosed. (The telescope was purchased in 1936, has a heavy, steady mounting on a concrete pier and an excellent clock drive, I still use it frequently, although I now have a 16-inch telescope and an observatory.)

It was the hardest image of Mars that I had ever seen. The clarity and hardness of the image were due in part to heavy fog, which was of just the right consistency to cut the glare and make the contrast just right. When I had finished the sketch (see attached drawing), water was running down the inside of the tube, and in another few minutes the flat diagonal mirror had dewed over.

I have always remembered this view—I could still draw the image from memory. It was amazing!

J. Russell Smith
Skyview Observatory
Eagle Pass, Tex.

Mr. Smith, a school science coordinator and author of the book TEACHING A UNIT IN ASTRONOMY, GRADES 1-9, *makes an interesting point and one that is little known. A fog, or a smoke haze, will often reduce glare and enhance contrast of bright, extended images such as those of the planets. Beyond this, the fog or haze, which owes its existence to atmospheric stability, seems to contribute even further to this stability.*



Mars on Oct. 1, 1941, as drawn by the writer under "ideal (?)" seeing conditions. Features are barely exaggerated, he indicates.

Numerous reports have been made, by British planetary observers Denning and Williams, for example, of unbelievable observations of Jupiter and Mars under conditions of heavy fog in Liverpool and other English coastal areas. The smoke palls of autumn, when fall leaves are burned and settle in stable layers several hundred feet above, frequently afford excellent views of the planets. Just how much of this "low-transparency, high-seeing" condition is accounted for by the smoke and how much by the stable condition of the lower air which allows the smoke pall to form is open to question, of course. Nevertheless, observers shouldn't always be cowed by these conditions, as Mr. Smith's excellent sketch of Mars attests.

Incidentally, Mr. Smith operates one of the country's better equipped amateur observatories. His equipment will be the subject of an article in the May-June issue of THE REVIEW OF POPULAR ASTRONOMY.

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FAN LETTER TO UNITRON...

from a man who DOESN'T own one...

HORACE MANN JUNIOR HIGH
P.O. BOX 458
BRANDON, FLORIDA

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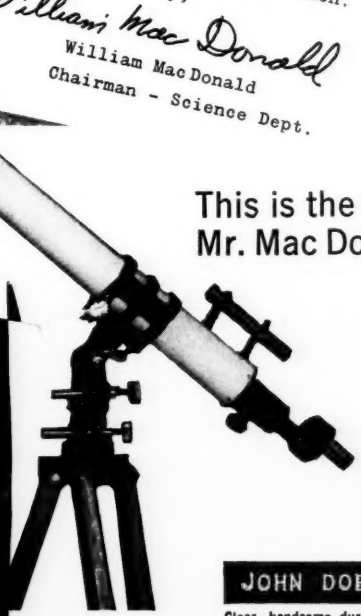

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